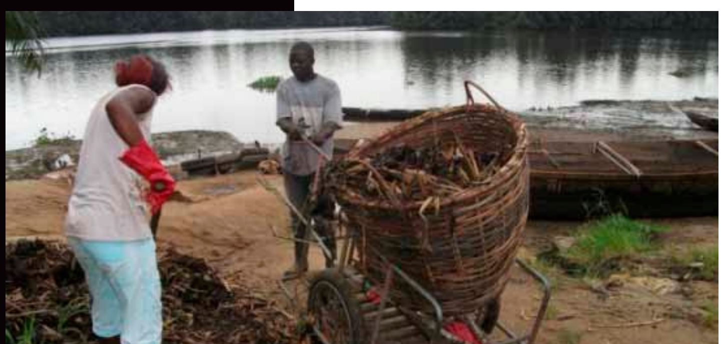
Secretariat of the Convention on Biological Diversity

CBD Technical Series No. 62

CONTRIBUTION OF ECOSYSTEM RESTORATION TO THE OBJECTIVES OF THE CBD AND A HEALTHY PLANET FOR ALL PEOPLE



Abstracts of Posters Presented at the 15th Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity, 7-11 November 2011, Montreal, Canada

Convention on Biological Diversity

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United Nations Decade on Biodiversity

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Cover Photos
(Top to bottom): A 200 year-old pine tree stands alone on the coastline, northeastern Japan. In the wake of the tsunami, it is the sole survivor of a pine tree forest that once held 70,000 trees (abstract no. 25)—Photo: BY-NC-ND 2.1 日本 Norifumi Otani. Restoring the Wouri River, Cameroon, by removing and composting water hyacinth (abstract no. 11)—Photo: Chi Napoleon Forpah, of WTG & Partners. Restored steppe fragment in Donetsk Botanical Garden, National Academy of Sciences of Ukraine (abstract no. 17)—Photo: Vladimir Kricsfalusy. Capacity building in San Benito community, Guatemala. Women make up over 80% of those involved in the harvesting, processing and selling of Maya Nut, a food derived from a native rainforest tree. The past century has seen the range of Maya Nut greatly reduced but within the past decade the species has become important in reforestation initiatives, child nutrition and the development of sustainable women-dominated micro enterprises (abstract no. 38)—Photo: Erika Vohman.

CONTENTS

FOREWORD

Biodiversity, and the ecosystems it forms, provides a range of benefits and services upon which society depends. However, the third edition of the Global Biodiversity Outlook (GBO-3) noted that despite the importance of biodiversity, it continues to decline globally, with major implications for the current and future well-being of people and the planet.

Habitat loss continues to be the main global driver of biodiversity loss. While efforts to prevent habitat decline remain of paramount importance, the restoration of degraded ecosystems will play an increasingly important role in the conservation and sustainable use of biodiversity, especially in light of the escalating impacts of climate change.

In many countries, degraded ecosystems represent immense opportunity for both biodiversity restoration and human health. When properly designed, the restoration of ecosystems is a proven, safe and immediately available means to protect biodiversity and the vital benefits it provides. Restored ecosystems can improve resilience of both ecosystems and societies, and generate additional benefits for people, in particular indigenous and local communities and the rural poor.

The tenth meeting of the Conference of the Parties to the Convention on Biological Diversity adopted the Strategic Plan for Biodiversity 2011-2020 and the 20 Aichi Biodiversity Targets as the overarching biodiversity framework for the world community. In adopting the Strategic Plan, countries noted the importance of health and restoration by explicitly referring to them in both the vision and mission of the Strategy. Furthermore, target 14 of the Aichi Biodiversity Targets directly relates to ecosystem restoration and its contribution to health and well-being, while target 15 identifies restoration as a means to contribute to climate change adaptation and mitigation and to combating desertification. Restoration can also make important contributions to the attainment of many other Aichi Biodiversity Targets.

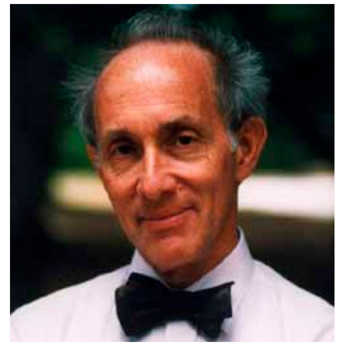
At its 15th meeting, in November 2011, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) will consider ways and means to support ecosystem restoration.

It is my hope that the lessons featured in this publication will feed into these discussions, inform the on-going work on restoration and further generate awareness of the links between biodiversity, restoration and human health.

I wish to extend my heartfelt thanks to all those who have taken the time to contribute abstracts for this issue of the CBD Technical Series and accompanying posters to be viewed during SBSTTA-15 in Montreal, in this, the first year of the United Nations Decade on Biodiversity.

Ahmed Djoghlaf
Executive Secretary
Convention on Biological Diversity

PREFACE



The eminent Harvard biology professor Edward O. Wilson once said about ants, "We need them to survive, but they don't need us at all." The same, in fact, could be said about countless other insects, bacteria, fungi, plankton, plants and other organisms. Yet, we humans often act as if we are totally independent of our environment, as if our driving thousands of other species to extinction, and disrupting the life-giving services they provide, will have no effect on us whatsoever.

The fundamental truth is that human beings are an integral, inseparable part of nature, and our health depends ultimately on the health of the natural world. Here are two examples from the award-winning book *Sustaining Life: How Human Health Depends on Biodiversity,* which I edited and authored with Dr. Aaron Bernstein:

> *Medicines from Nature.* Nature has been providing medicines to treat our diseases for thousands of years. Most prescribed medicines are still derived from, or patterned after, natural compounds, including morphine from the opium poppy and aspirin from the white willow tree. Polar bears, for instance, do not lose bone mass despite seven months or more of immobility, nor do they become toxic despite not urinating, nor does their massive obesity prior to entering hibernation cause Type II diabetes. If we lose polar bears in the wild, we may lose with them the secrets they hold for treating, and possibly preventing, osteoporosis, kidney failure and obesity-related diabetes.
>
> *Infectious Diseases and Deforestation.* While deforestation typically reduces forest mosquito diversity, the species that survive and become dominant, for reasons that are not well understood, almost always transmit malaria better than the species that had been most abundant in the intact forests. This has been observed essentially everywhere malaria occurs—in the Amazon, East Africa, Thailand and Indonesia.

Most people experience the loss of other species and the disruption of ecosystems as intangible, abstract events, separate from themselves. In spite of this, they may feel these losses deeply—ethically, spiritually and aesthetically—and may even understand some of the ecological and economic costs involved. Yet, it is still difficult for them to grasp what this impoverishment of nature has to do with their everyday lives, and in particular, their health.

For those of us working to preserve or restore biodiversity, this publication by the Secretariat of the Convention on Biological Diversity is timely as we must convince others, policymakers and the public, that we are intimately connected with biodiversity, and totally dependent on the goods and services that ecosystems provide. We have no other choice but to preserve biodiversity, use it sustainably and do our best to restore ecosystems globally. At the Center for Health and the Global Environment at Harvard Medical School, we believe that once people really grasp what is at stake for their health and their lives, and for the health and lives of their children, they will do everything in their power to protect and restore the living world.

Eric Chivian MD

Eric Chivian M.D.
Founder and Director of the Center for Health and the Global Environment,
Harvard Medical School
Shared 1985 Nobel Peace Prize

1. RE-ESTABLISHING AN ECOLOGICALLY HEALTHY RELATIONSHIP BETWEEN NATURE AND CULTURE: THE MISSION AND VISION OF THE SOCIETY FOR ECOLOGICAL RESTORATION

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Keywords: ecological restoration, biodiversity, ecosystem services, local and indigenous communities, ecological integrity, resilience

WHAT IS ECOLOGICAL RESTORATION?

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (SER2004). An ecosystem is said to be degraded when it exhibits a loss of biodiversity and a simplification or disruption in ecosystem structure, function and composition caused by activities or disturbances that are too frequent or severe to allow for natural regeneration or recovery. Degradation results from various factors and drivers which are often interlinked. Most of these are directly or indirectly related to human activities, such as the unsustainable use and management of land, water and other resources, climate perturbations, and extreme events (e.g. drought, fire, and storms) which reduce the quality and flow of ecosystem goods and services. Ecological restoration becomes necessary when these activities or disturbances render the impacted ecosystem incapable of self-repair.

Ecological restoration is an intentional activity that initiates or facilitates the recovery of ecosystems by re-establishing a beneficial trajectory of maturation that persists over time. The science and practice of ecological restoration is focused largely on reinstating autogenic ecological processes by which species populations can self-organize into functional and resilient communities that adapt to changing conditions while at the same time delivering vital ecosystem services. In addition to reinstating ecosystem function, ecological restoration also fosters the re-establishment of a healthy relationship between humans and their natural surroundings by reinforcing the inextricable link between nature and culture and emphasizing the important benefits that ecosystems provide to human communities.

THE SOCIETY FOR ECOLOGICAL RESTORATION: SUPPORTING ACTION ON THE GROUND

The Society for Ecological Restoration (SER) is a non-profit organization comprised of individuals and partner organizations from around the world who are actively engaged in the repair and recovery of degraded ecosystems utilizing a broad array of experiences, knowledge sets, and cultural perspectives. SER members include scientists, planners, administrators, consultants, indigenous peoples, landscape architects, teachers, artists, engineers, natural resource managers, farmers/growers, community leaders, and volunteers. Founded in 1987, SER now has members and partners in more than 60 nations with chapters and networks serving states, provinces and regions of North America, Europe, Latin America, and Australia. SER is also working actively to expand its presence in Asia and Africa.

SER's mission is to ***promote ecological restoration as a means of sustaining the diversity of life on Earth and re-establishing an ecologically healthy relationship between nature and culture.*** SER's primary focus is to advance the science and practice of ecological restoration as a tool for recovering biodiversity and ecosystem services, and thereby addressing some of the most pressing environmental challenges facing humanity and the biosphere: namely desertification, land and water degradation, and the associated loss of sustainable livelihoods. In addition, ecological restoration plays an important role in ameliorating the drivers and effects of climate change by increasing carbon storage capacity, global thermal reflectance, and ecosystem resilience.

SER is positioned at the critical interface between science and practice in order to support and promote participatory, knowledge-based restoration projects and programs around the world. Restoration activities are necessarily site specific and vary widely according to bio-physical variables and social, economic and cultural values. These activities may include species re-introductions, the removal of harmful invasive species, and the repair of dysfunctional aspects of terrestrial, coastal and aquatic ecosystems. In some cases, successful restoration outcomes can be achieved by a single activity, such as restoring hydrological function, re-introducing an appropriate fire regime, or conducting revegetation with keystone native plant species. SER supports the work of its members, partners, and others in the field, by:

Facilitating communication and exchange: SER organizes biennial world conferences, regional chapter meetings and workshops to provide opportunities for scientists, practitioners, volunteers and community leaders to exchange ideas, showcase their work, and forge new alliances; SER also provides a broad array of restoration resources through a number of web-based networks such the Global Restoration Network, Indigenous Peoples' Restoration Network, and Community Restoration Network.

Sharing information and knowledge: SER publishes the peer-reviewed journal *Restoration Ecology*, which highlights the results of restoration projects worldwide, conceptual advances and new perspectives in the field; SER also publishes a book series in association with Island Press called the *Science and Practice of Ecological Restoration*, which now includes over 25 titles for scientists, practitioners, students, volunteers, and natural resource managers.

Informing decision-makers: SER produces occasional briefing notes, policy position statements and technical documents like the *SER International Primer on Ecological Restoration* and contributes to the publications of other bodies such as the UNEP Rapid Response Assessment entitled *Dead Planet, Living Planet: Biodiversity and Ecosystem Restoration for Sustainable Development*. SER is a long-standing member of the International Union for the Conservation of Nature (IUCN), and an observer organization to the Convention on Biological Diversity (CBD) and the Ramsar Science and Technical Review Panel.

SER'S VISION FOR A DESIRABLE AND SUSTAINABLE FUTURE

Ecological restoration is a powerful strategy for reversing biodiversity loss, increasing the provision of ecosystem services, and contributing to sustainable livelihoods. What makes restoration uniquely valuable is its inherent capacity to provide people with the opportunity not only to repair ecological damage, but also to improve the human condition (SER/IUCN 2004). By ensuring and enhancing the provisioning, regulating and cultural services provided by ecosystems (MA 2005), ecological restoration holds significant potential for increasing economic benefits, strengthening communities, and giving hope where it has been lost (TEEB 2010).

SER endorses the Ecosystem Approach. Indeed, the following principles and best practice guidelines, actively promoted by SER (SER 2005), are shared by the CBD: (1) the recognition of essential linkages between social/cultural and ecological systems; (2) the identification of drivers of degradation and need for connectivity within and between ecosystems; (3) the need to engage and empower stakeholders, particularly local and indigenous communities; and (4) the application of adaptive management and long-term monitoring strategies for protected areas, land- and seascapes, and restored ecosystems.

SER's vision for a sustainable and desirable future - where people live and work with nature - requires both bottom-up and top-down planning that includes the implementation of conservation programs, sustainable resource use and management, and an increasing investment in restoration activities. This vision calls for concerted and collaborative efforts among all stakeholders involved in managing natural capital in the public, private and NGO sectors, and the development of frameworks for nested governance and vertical integration to provide them with the guidance they need to ensure successful restoration outcomes and the equitable distribution of ecosystem benefits. With this vision in mind, the delegates at SER's 4th World Conference on Ecological Restoration issued a Call to Action to the Parties of the CBD (see Appendix 1).

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Appendix 1: SER2011 Call to Action

This is a call to action from the 1000 delegates—representing scientists and practitioners, environmental NGOs, private corporations, government agencies, and community and indigenous leaders from over 60 countries – who gathered in Merida, Yucatan, Mexico from August 21-25, 2011. The delegates addressed many of the challenges and opportunities associated with restoring ecosystems and re-establishing the essential link between nature and culture. Recognizing the critical importance of our global ecological infrastructure as the foundation for biodiversity conservation and ecosystem resilience, sustainable livelihoods, and future economic prosperity, the delegates strongly urge the CBD Parties to act swiftly to deliver on the restoration commitments embedded in the new Strategic Plan 2011-2020 and the Aichi Biodiversity targets, and to:

- Integrate ecological restoration into National Biodiversity Strategies and Action Plans (NBSAPs) as well as legislative and regulatory frameworks which include all sectors of society that use and manage natural capital;
- Increasingly use ecological restoration as a tool in ecosystem-based adaptation and mitigation strategies that enhance social and ecological resilience and carbon sequestration and storage;

- Prioritize the immediate need to reinstate the flow and improve the quality of ecosystem services to alleviate poverty and increase human well-being while taking into account social, cultural, economic and political values;
- Increase stakeholder involvement, public education and awareness to effectively engage local and indigenous communities in restoration activities and safeguard their right to a healthy and sustainable future;
- Support and promote investments and incentive mechanisms, such as Payments for Ecosystem Services (PES) and other innovative financial mechanisms, to restore degraded ecosystems and landscapes that provide multiple co-benefits to biodiversity, ecosystems, and communities;
- Increasingly use ecological restoration to improve connectivity within and between protected areas and other ecosystems that are critical for biodiversity conservation, and to increase their adaptive capacity through the restoration of degraded habitats, landscapes, and seascapes; and
- Adopt guidance for establishing priorities and the goals of restoration activities, and facilitating the transfer of knowledge, tools and technologies.

The SER2011 delegates also call on the World Bank, Global Environmental Facility, and other multilateral and bilateral funding institutions to support, through capacity building and other means, the development and implementation of national and sub-national ecological restoration projects and programs.

2. RESTORING OUR WETLANDS: AN IMPORTANT TOOL FOR IMPROVING ECOSYSTEM SERVICES AND ENHANCING HUMAN WELL-BEING

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Keywords: wetland restoration, ecosystem services, Ramsar Convention

BACKGROUND

Globally, wetlands are threatened. In parts of North America, Europe, Australia and New Zealand more than 50% of specific wetland types were drained or lost during the twentieth century. Estimates suggest that many wetland species are in decline (MA 2005). Climate change, acting in consort with a range of other pressures such as changes in the quantity and quality of water supply, is expected to exacerbate the loss and degradation of wetlands (Erwin 2009). This brings with it a commensurate impact on human society. It has long been established that wetlands deliver a range of valuable ecosystem services and it has been argued that these benefits should act as powerful incentives to conserve nature (Balmford et al. 2002). Increasingly, society is acknowledging the essential link between healthy wetlands and human well-being, and incentives are being sought to encourage the restoration of degraded ecosystems concurrent with the wise use of existing resources (Jenkins et al. 2010; Finlayson et al. 2011).

For over 40 years, the Ramsar Convention has recognized the interdependence of people and their environment and is the only global intergovernmental convention addressing the interactions between water and wetland ecosystems. It has promoted the wise use of wetlands as a means of maintaining their "ecological character" - the ecosystem components and processes that comprise the wetland and provide ecosystem services, i.e. water purification, nutrient cycling, food, recreation, and cultural values. The tenth Conference of the Parties (COP10) to the Ramsar Convention passed Resolution X.10 specifically requested the Convention's Scientific and Technical Review Panel (STRP) to:

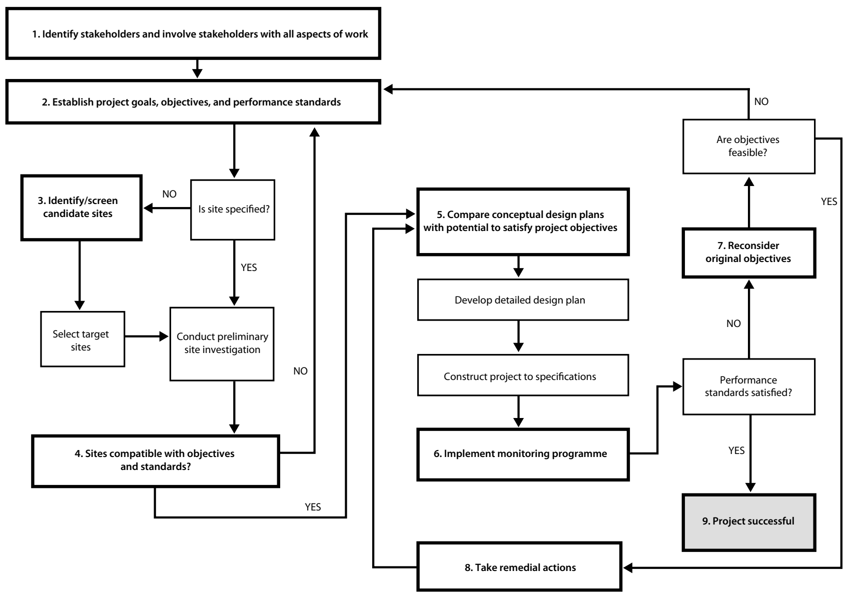
> Prepare proposals for updating and expanding existing Ramsar guidance on restoration and rehabilitation of lost or degraded wetlands, in the context of Resolution X.16 on *A Framework for processes of detecting, reporting and responding to change in ecological character*, including approaches to prioritization and links with other Ramsar tools and guidance, *inter alia* those on climate change and on economic values of ecosystem services.

RAMSAR WETLAND RESTORATION GUIDANCE

The literature abounds with published articles and documents on wetland restoration, covering everything from individual case studies, generic guidance, regional applications, wetland-type specific approaches to re-establishing connectivity within the watershed. The Ramsar Convention has produced a synthesis of the principles and guidelines for wetland restoration for use by the Parties (Resolution VIII.16 and Ramsar Convention Secretariat, 2010). The existing Ramsar guidance describes a clear pathway outlining the process of wetland restoration (Figure 1). In response to the request made at COP10, the STRP has reviewed the existing Ramsar guidance. The following activities were conducted as part of the review process:

- The existing Ramsar guidance was subject to a systematic review by the STRP;
- Five technical workshops were held to seek input into the development of proposals and to provide clarification and insight regarding the utility of the existing guidance (Table 1);
- A questionnaire was produced to assist in eliciting information from the attendees on a range of issues relating to wetland restoration and used to follow-up after the workshops; and
- Sessions were conducted at the mid-term workshops and STRP16 to assist in developing proposals and to investigate the utility of the existing guidance.

FIGURE 1: Ramsar guidelines for wetland restoration.



The systematic review identified that the majority of Contracting Parties (CPs) are involved in wetland restoration and over half of them are currently using the existing guidance. Guidance is currently being applied to a range of wetland types and to address a variety of drivers, however specific wetland types may require additional specific guidance. Restoration has been recognised by the CPs as a realistic response option under a range scenarios including *inter alia* addressing changes in ecological character at a Ramsar site, enhancing biodiversity, improving livelihoods, and mitigating and adapting to climate change. The workshops and questionnaire results confirmed that the guidance in its current format contains much useful and quality policy/planning-related information and addresses the essential elements expected within restoration guidance. However, whilst the pedigree of the guidance is good, it currently only provides a generic and policy/planning-related approach to wetland restoration rather than specific end-user targeted guidance which reduces its utility in many circumstances.

MOVING FORWARD WITH WETLAND RESTORATION

The Ramsar Convention is moving forward with reviewing and developing proposals to enhance the utility of its existing guidance. In parallel, the wetland scientific community is developing case studies and improving best practice guidance. There is a need to enhance the science-base which links wetland restoration with the benefits of improved ecosystem service delivery, for instance in understanding biogeochemical cycling (Pataki et al. 2011) or in sustaining human health (Horwitz and Finlayson 2011). Given the extent of wetland degradation, the spread of invasives and the effects of climate change, it is often not ecologically or economically feasible to restore a wetland to its historical conditions. Increasingly, wetland restoration initiatives focus on reinstating structure, function, and composition to the benefit of biodiversity, ecosystems and human communities. Even when restoration to a historical reference condition is not possible, wetland restoration still provides opportunities to deliver on a range of local, national and global policy objectives, such as the Aichi Biodiversity Targets or contributing to REDD+ (Alexander et al. 2011). Irrespective of the drivers of wetland restoration, there is a need to ensure that decision-makers across a variety of sectors co-ordinate their efforts and recognise the multiple benefits that restoring wetlands can bring to human society.

TABLE 1. Summary of key outcomes from wetland restoration workshops.

LOCATION	ISSUES AND OUTCOMES
Avignon, France, August 2010	• Need for uniform definitions on wetland restoration and information supporting its value and application across government sectors • Need for detailed technical guidance for practitioners across the full range of wetland restoration process, including locally relevant examples of restoration (case studies) • Need to set clear objectives for restoration and management of wetlands • Need to establish protocols for monitoring
Lower Volga, Russia, November 2010	• Need for greater guidance on prioritising sites for restoration across a large area, including those where re-establishment of the original hydrological regime is not achievable • Need to understand the achievability of the desired reference condition for restoration • Need for guidance on communication and education to support restoration planning
Johannesburg, South Africa, December 2010	• Need to distinguish direct human induced changes in wetlands from climate change • Good use of a hydrogeomorphic approach to prioritising sites for restoration
Seattle, USA, May 2011	• Need for uniform definitions on wetland restoration • Need for detailed technical guidance for practitioners across the full wetland restoration process, including locally relevant examples of restoration (case studies) • Need to establish protocols for monitoring
Beijing, China, June 2011	• Need for a clearer policy statement on wetland restoration and its value and application across government sectors • The need for detailed technical guidance for practitioners across the full wetland restoration process, including locally relevant examples of restoration. • Need to set clear objectives for restoration • Importance of demonstration sites as outdoor laboratories, for raising awareness and showcasing to policy-makers • Importance of translation of guidance into local or regional languages • Require workshops and information exchange between policy makers, practitioners and researchers

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3. RESTORATION AND REMEDIATION OF KUWAIT'S DAMAGED NATURAL RESOURCES AS A CONSEQUENCE OF WAR

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Keywords: Native plants, terrestrial ecosystems, arid lands, oil pollution, soil, groundwater, vegetation

ABSTRACT

As a consequence of Iraqi invasion and aftermath wars, the environment of Kuwait suffered great losses in natural resources, such as vegetation, groundwater, marine and terrestrial fauna. The Monitoring and Assessment Program resulted in awarding Kuwait by the United Nations Compensation Commission (UNCC) about US$ 2.95 billion to restore and remediate the environment. Remediation projects include treatment of contaminated soil in groundwater, oil-lakes, wellhead pits, coastal and marine and tarcrete. Restoration projects include establishment of 5 protected areas, marine protected areas and large-scale re-vegetation of military damaged areas using native plants. Although Kuwait must comply to UNCC Decision 258 in the implementation of the program however, many new technologies have been developed that need to be assessed and considered in the remediation and restoration efforts. Kuwait National Focal Point (KNFP) is the body responsible for the supervision of the implementation, which will be conducted by the stakeholders (mostly governmental organizations) in collaboration with international organizations. KISR is responsible for Management and Supervision of the Program.

The large-scale re-vegetation of the degraded lands is a unique experience for the arid environment of Kuwait that requires development of mass propagation of keystone species, nurseries and protocols for native plants production and capacity building. Supplement irrigation with fresh water is necessary in early stage of establishment of native plants. Monitoring of ecological functioning of ecosystems and resources shall be conducted to ensure the effectiveness of the remediation and restoration measures.

INTRODUCTION

The State of Kuwait sustained significant and widespread environmental damages resulting from the Iraqi aggression against Kuwait on 2nd August 1990 and the 1991 Gulf War, which ended on 26th February 1991. In 1994, the Government of the State of Kuwait appealed to United Nations Compensation Commission (UNCC) to procure funding to remediate and restore environmentally damaged areas throughout the State of Kuwait. By December 2005, the UNCC completed the review of all claims for environmental damages and had awarded the State of Kuwait about U.S. $2.95 billion to remediate environmental damages. The UNCC issued Decision 258 laying out the rules and guidelines for the Claimant Governments during the planning and implementation of environmental remediation projects. Claimant Governments were requested to establish National Focal Points (NFP) to supervise the remediation and restoration projects within each country, and to act as a liaison with the UNCC during this follow-up program. This manuscript provides highlights of the remediation and restoration program which has been considered by the UNCC for the implementation of the Kuwait Environmental Remediation Program (KERP).

ENVIRONMENTAL REMEDIATION PROJECTS

Most of the damages on the environment were from the aftermath of the burning and gushing of around 800 oil wells, which were exploded. The gushing oil and fallout from the oil fire plumes spread over the desert surface covering about 114 km^2. The deposited oil formed in places close to the oil wells, lakes of various dimensions as well as thin films or crust of oil (tarcrete) spreading over areas far away from the oil wells. The released oil reached areas of fresh groundwater aquifers in the northern parts of Kuwait, and contaminated natural resources in Kuwait. Environmental remediation is the process that aims at rectifying damages to the environment caused by various factors. There are many different concepts and approaches to environmental remediation. A key decision for any environmental remediation/restoration process is the choice of reference environment to serve as the basis for evaluating remedial options and their effectiveness. These reference areas are being identified and monitored. Various types of technologies and methodologies may be applied to achieve the specific environmental remediation objectives. The approach for remediation of about 26 million highly contaminated soil, e.g., oil lakes having an average 20% oil, was to excavate, transport and landfill this material as well as to biologically remediate the residual less contaminated soils. Pilot scale remediation technologies however, are being considered to provid more sustainable and environmentally sound approaches (KNFP 2011). One challenging aspect of the remediation projects is the presence of unexploded mines and munitions (UXO). Recent technologies for clearance of UXO are being considered in the remediation program (UNCC 2004).

ENVIRONMENTAL RESTORATION PROJECTS

Military activities by all sides contributed to the environmental damages. The movement of vehicles and heavy armaments and the opening of hundreds of trenches and foxholes throughout Kuwait destroyed the fragile desert environment by affecting the vegetation cover, which in turn impacted the sensitive ecosystem (UNCC 2003). Five protected areas have been proposed to restore the damaged terrestrial environment. About 80 km^2 are to be re-vegetated by using keystone native plant species such as: *Rhanterium epapposum, Haloxylon salicornicum, Panicum turgidum and Cyperus conglomeratus*, which are primarly plant communities in Kuwait. The large-scale restoration program requires horticultural paractices for production of seeds and plants in large quantities. Water sources for irrigation and irrigation systems have been considered in early development of plants.

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4. RESTAURACIÓN Y ADAPTACIÓN AL CAMBIO CLIMÁTICO EN ÁREAS PROTEGIDAS DE MÉXICO

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Palabras clave: Restauración, Adaptación, Cambio Climático, Biodiversidad, y Conservación.

INTRODUCCIÓN

De acuerdo con la Evaluación de Ecosistemas del Milenio, a nivel mundial existen cinco principales impulsores de cambio de la biodiversidad, uno de ellos es el cambio climático, pues se estima que tendrá consecuencias graves en los ecosistemas como, aumento en la temperatura global, modificación en los patrones de precipitación, cambios en los ciclos biológicos, aumento en el nivel del mar, entre otros, lo que en conjunto impactará negativamente a la biodiversidad a nivel mundial incrementando la vulnerabilidad de los ecosistemas y poblaciones humanas. El panorama para México se hace más urgente si se considera que forma parte del selecto grupo de países megadiversos, con alrededor del 12 % de la biodiversidad mundial y con muchas especies con distribución restringida al país.

Una de las estrategias más eficientes para mitigar y adaptarse a los impactos del cambio climático en la biodiversidad ha demostrado ser el establecimiento y administración efectiva de áreas naturales protegidas pues el manejo y conservación de los ecosistemas permite mantener los bienes y servicios que estos proveen como la captación e infiltración de agua, ciclaje de nutrimentos, captura de carbono, regulación climática y protección ante los fenómenos meteorológicos extremos, entre otros.

En México la institución del gobierno federal encargada de la protección del Capital Natural es la Comisión Nacional de Áreas Naturales Protegidas. En el año 2010 desarrolló una estrategia de Cambio Climático para Áreas Protegidas, un documento que enlista las estrategias y acciones para mitigar el cambio climático, identificar y aplicar medidas prioritarias para la adaptación, y establecer directrices para las decisiones de gestión de la Comisión Nacional. La estrategia considera dos componentes operativos principales, la mitigación, que tiene como objetivo reducir las emisiones de gases de efecto invernadero por deforestación y degradación de los bosques en las áreas protegidas y sus zonas de influencia, y aumentar los sumideros de carbono en las mismas; y la adaptación, que tiene como objetivo reducir la vulnerabilidad de los ecosistemas y sus comunidades humanas, aumentando la resiliencia de los ecosistemas.

LA RESTAURACIÓN ECOLÓGICA COMO UNA HERRAMIENTA DE ADAPTACIÓN AL CAMBIO CLIMÁTICO.

Como parte de la implementación del componente sustantivo de Adaptación de la ECCAP, la CONANP en colaboración con la organización de la Sociedad Civil, Fondo Mexicano de Conservación de la Naturales A.C. (FMCN) actualmente realiza el proyecto “Desarrollo de Programas Piloto de Adaptación al Cambio Climático en Áreas Naturales Protegidas del Sureste de México “ que busca elaborar en cuatro complejos de Áreas Naturales Protegidas (ANP) del Sureste de México una metodología para la adaptación en paisajes enmarcados con áreas naturales protegidas, que oriente y apoye el diseño e implementación de medidas de adaptación al cambio climático, con la finalidad de mantener funcionales a los ecosistemas, al germoplasma y a los servicios ecosistémicos para las comunidades usuarias de los recursos naturales.

En el cartel se expone el caso del Programa de Adaptación para el complejo "Selva Zoque" una de las regiones más diversas de México, en donde los escenarios de cambio climático para esta zona apuntan a un aumento en la temperatura promedio y una disminución en la precipitación. En ese contexto, el análisis de vulnerabilidad identificó como hipótesis de cambio principal al posible aumento en la frecuencia y magnitud de los fuegos forestales con consecuencias muy graves en la biodiversidad. Se encontraron 13 grandes estrategias de adaptación al cambio climático, entre las que destacan el promover la resiliencia y competitividad de las actividades productivas, la implementación de un sistema de alerta temprana de fuegos forestales y la promoción de la interconexión de ecosistemas a través de la restauración de ecosistemas.

Este conjunto de acciones donde la restauración ecológica juega un papel muy importante, buscan promover la resiliencia de los sistemas naturales y humanos ante los posibles impactos del cambio climático, siempre considerando la coordinación de distintos sectores como el académico, la sociedad civil e instituciones de gobierno.

México atiende al objetivo número uno del CDB de Conservar la Biodiversidad por medio de fortalecer la resiliencia de los ecosistemas usando la restauración ecológica como una estrategia de interconectar las áreas naturales protegidas del sureste mexicano.

5. EFECTIVIDAD DE UN DISEÑO FLORÍSTICO PARA EL CONTROL DEL RETAMO ESPINOSO *ULEX EUROPAEUS* L. EN LA VEREDA EL HATO, LOCALIDAD DE USME, BOGOTÁ, COLOMBIA.

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Palabras claves: Restauración ecológica, Especies invasoras, Diseño florístico, Monitoreo.

INTRODUCCIÓN

Los ecosistemas de Bogotá D.C: páramos, humedales, bosques alto andinos, entre otros, son bienes que proveen servicios ecosistémicos para posibilitar la sostenibilidad de la población capitalina, el bosque alto andino al igual que los páramos captura y dispone el agua en forma regulada, en la medida en que la capa vegetal ayuda a debilitar el impacto de las precipitaciones, y la vegetación boscosa absorbe el agua, llevando a la filtración de una manera gradual hacia los suelos y cauces hídricos, generando una disminución en la probabilidad de inundación(Garibello 2003); desafortunadamente el bosque alto andino ha sido destruido en su mayor parte, para dar paso a la minería, al pastoreo, monocultivos, impiden la recolonización del bosque. Estas intervenciones antrópicas modifican de manera contundente los ecosistemas, generando una pérdida parcial o completa de su función y composición (Salamanca y Camargo, 2000).

Estos disturbios, facilitan la invasión de plantas exóticas, como es el caso de *Ulex europaeus* (retamo espinoso), generando un gran impacto ecológico, siendo considerado como la segunda causa de pérdida de diversidad; provocando altos costos para su control y erradicación (Vargas *et al.* 2010), por lo anterior se emplea la restauración ecológica como una estrategia de gestión ambiental encaminada a restablecer el capital natural deteriorado, buscando la recuperación y/o rehabilitación de los antiguos paisajes nativos de la zonas afectadas.

Esta investigación es una experiencia piloto de Restauración Ecológica que busca recuperar zonas invadidas por *U. europaeus*, provocando el cambio de cobertura vegetal, atreves de un mosaico de vegetación arbustiva y arbórea nativa, por medio de la superación de barreras que limitan la regeneración natural; se pretende recuperar la trayectoria sucesional hacia bosque alto andino, mediante la restauración de atributos estructurales, funcionales y de composición (Wolfungel 2010).

METODOLOGÍA

Se implementaron módulos de plantación con 54 individuos de especies pioneras, secundarias y climácicas plantadas a tres bolillo distantes 0,75m en un área de 45,83 m^2 conformado por especies herbácea *Vicia benghalensis (*44), arbustivas *Baccharis bogotensis (4)* y *Lupinus miriabilis (54*) y arbóreas *Smallanthus pyramidallis* (21), *Escalonia paniculata* (3) y *Alnus acuminata* (1), con 3 réplicas en dos sectores, ubicados dentro del corredor ripario. A partir del tercer mes de la siembra, se evaluó la vegetación plantada en crecimiento, altura, cobertura, Diámetro basal, estado fitosanitario, fisiológico, fenológico y la composición, estructura y abundancia de la vegetación asociada.

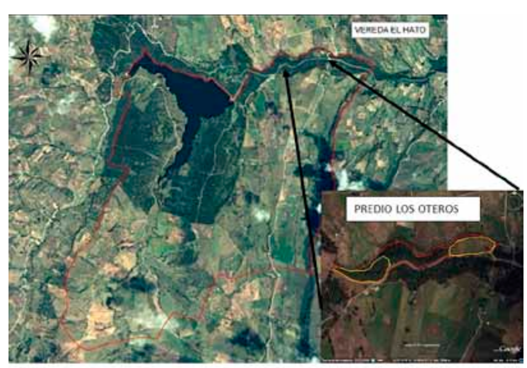

FIGURA 1: Localización predio los Oteros y zonas de monitoreo. Tomado de Google Earth ©, 2011**.**

RESULTADOS

Los resultados parciales muestran una mayor tasa de crecimiento en la especie, *Baccharis bogotensis* con altura promedio en la zona B de 0,00867 cm/día y desviación estándar (σ) de 0,00586, en cobertura y diámetro basal, *Lupinus miriabilis* con promedió de 0,00781 cm^2/día (σ 0,00909) y 0,00198 cm/día (σ 0,00460) respectivamente, a nivel fitosanitario la especie menos afectada fue *Baccharis bogotensis*, las otras especies presentan diversos síntomas (agallas, ácaros, hongos, roya) los cuales varían dependiendo de la temporada seca o de lluvia. Los porcentajes de supervivencia de los individuos plantados superan el 80% y la especie que mayor mortalidad presento fue *Smallanthus pyramidalis,* con un 19,05%, esto probablemente porque fue la especie mas afectada en la temporada seca.

FIGURA 2: Mosaico de algunas especies de la vegetación asociada encontrada dentro y fuera de las replicas plantadas

En relación a la vegetación asociada hay un registro parcial de 17 familias como Asteracea, Fabacea, Equisetacea, 30 géneros y 31 especies entre las cuales están *Veronica pérsica*, *Drymaria villosa* y *holcus lanatus*, entre otros (figura 2); se presenta una mayor riqueza relativa en la zona B en relación a la zona A, característica que fue constante en los tres monitoreos; en relaciona a la cobertura se observó un aparente decrecimiento en *Ulex europaeus*, en relacion a la cobertura alcanzada entre las especies asociadas en las parcelas internas y externas en la zona A y B.

RECOMENDACIONES

Actualmente esta investigación se encuentra en fase de análisis estadístico por lo tanto los resultados aquí descritos son solamente descriptivos.

Aunque el arreglo florístico se monitoreará durante dos años se tomaron en cuenta únicamente los tres primeros datos colectados, por lo que se recomienda utilizar la totalidad de monitoreos, lo cual se plantea en una segunda etapa a los cuatro y seis meses.

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6. THE ATLANTIC FOREST RESTORATION PACT—A MAJOR EFFORT BY BRAZILIAN SOCIETY TO RESTORE AND TRANSFORM ITS MOST THREATENED BIOME

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Keywords: Environmental Policy, Green Jobs, Large-scale Ecological Restoration, Tropical Forest Restoration

The Brazilian Atlantic Forest is a majestic and irreplaceable repository of biodiversity, with approximately 20,000 species of plants and 936 bird, 475 amphibian, 306 reptile, and 263 mammal species. By comparison, all of North America has only 17,000 plant species, while the entire European continent has only 12,500. Due to this exceptional biological diversity, very high levels of endemism and, unfortunately, a dramatically threatened future, the Brazilian Atlantic Forest is one of the five top priority conservation areas in the world. Yet another treasure-like feature of the Atlantic Forest is that it supplies fresh water, clean air, and climate stability, among other ecosystem services, for more than 110 million Brazilians, which represent more than 60% of the country population.

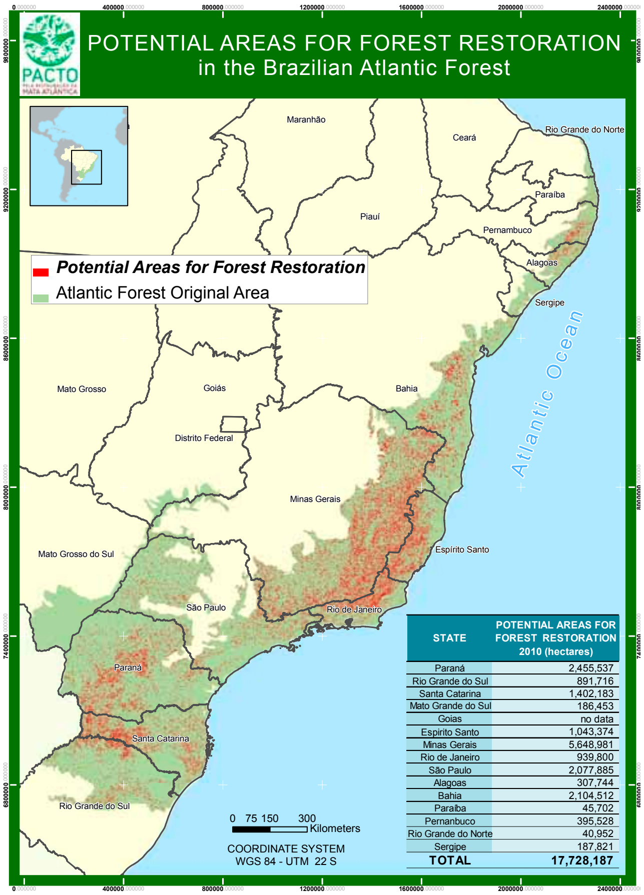
Tragically, during the last 500 years, the Atlantic Forest has lost almost 90% of its pre-European Conquest cover. The highly altered landscapes that we see today upslope and surrounding the country's major urban and industrial centres, have been shaped by successive cycles of economic and social development; some were disastrous boom-and-bust cycles, while others were more gradual but just as profound.

ON THE NEED OF LARGE-SCALE RESTORATION INITIATIVES TO SAVE THE BRAZILIAN ATLANTIC FOREST

Recent analysis of the dynamics of fragmentation in the Atlantic Forest biome shows the seriousness of the situation: instead of the continuous forest that once existed, there are now thousands of small forest fragments, mostly less than 50 hectares in size and privately owned; less than 2% of the remaining forest lies within legally protected areas (Ribeiro et al. 2009). In this problematic scenario, conservation will not be enough to save most of the indigenous species of the Atlantic Forest, and then ecological restoration must take place relatively quickly, and at a large scale. Fortunately it is now well understood that large areas of Atlantic Forest need to be restored for their innate conservation value for the ecosystem services they provide, and, in those landscape units where restoration is obligatory, so that landowners can comply with State and federal laws. Both legal reserves, and permanent preservation areas, have been federally designated with growing precision. All such areas must now be conserved or reforested—with an aim to achieve restoration—in order for landowners to comply with the Brazilian Forest Law. To achieve the expected targets, restoration efforts must be integrated with stakeholders and a fully mobilized society at large. This spirit of cooperation and mobilization is the essence of the Atlantic Forest Restoration Pact—AFRP (Calmon et al. 2011). Our basic premise is that biodiversity conservation of the Atlantic Forest depends on large-scale, holistic restoration strategies in order to promote the preservation of natural cycles and gene flow, the huge wealth of native biodiversity, and the myriad ecosystem services generated by the forests (climate regulation, soil protection, and enhancement of water quality and quantity, etc.). To ensure their existence for future generations, and the survival of the species that live there, we must not only maintain, but also restore and reconnect, insofar as possible, isolated Atlantic Forest fragments.

A PACT TO TRANSFORM THE ATLANTIC FOREST

Inspired by its beauty and importance, and by the urgent need to save the threatened Atlantic Forest, the idea emerged in 2006 to coalesce existing efforts, integrate them in a coherent movement, and create synergies among all the actors working towards restoration and reintegration throughout the region. Finally, after much preliminary work, on April 7, 2009, the AFRP was launched. Today, less than two years later, the AFRP has almost 200 members including national and international NGOs, government, private companies, and research institutions. The AFRP's vision is to integrate people and organizations to restore and reconnect the Atlantic Forest at a very large scale, and to protect the remaining forest fragments, by promoting: (a) Conservation of biodiversity, (b) Generation of jobs and income; we estimate that the fully accomplishment of the AFRP will generate by 2050 a total of 6 million jobs, most of them in rural communities, (c) Maintenance and payment for environmental services, and (d) Supporting farmers' ability and willingness to comply to State and national legal instruments, and the national Forest law – a series of laws that exists since many years but is still under revision (Calmon et al. 2011). The ambitious goal is to contribute to restore 15 million hectares of Atlantic Forest by 2050 (Figure 1), with annual targets to be met, and on-going monitoring, evaluation, outreach, and reporting of results to be carried out (see more details at http://www.pactomataatlantica.org.br/index.aspx?lang=en). Actually, more than 40,000 ha of restoration projects were already registered in the AFRP website. We have also produced thematic maps to guide restoration efforts for payments for ecosystem services (carbon, water, and biodiversity), landscape connectivity, and economic models of restoration.



STATE	POTENTIAL AREAS FOR FOREST RESTORATION 2010 (hectares)
Paraná	2,455,537
Rio Grande do Sul	891,716
Santa Catarina	1,402,183
Mato Grande do Sul	186,453
Goias	no data
Espirito Santo	1,043,374
Minas Gerais	5,648,981
Rio de Janeiro	939,800
São Paulo	2,077,885
Alagoas	307,744
Bahia	2,104,512
Paraíba	45,702
Pernanbuco	395,528
Rio Grande do Norte	40,952
Sergipe	187,821
TOTAL	**17,728,187**

FIGURE 1. The figure shows portions of private lands that are protected by the Brazilian Forest Act, or represent marginal areas for agriculture (> 15° of slope incline) that have been identified (red dots) by the Atlantic Forest Restoration Pact as suitable for forest restoration efforts without competing with profitable agriculture and cattle ranching.

The restoration efforts include native tree planting and other measures to promote of natural forest regeneration by removing threats that lead to degradation. Our goal is that by 2050 at least 30% of the original Atlantic Forest biome's area will have been returned to native forest cover or will be undergoing restoration. Now that our long-term vision has been established, based on scientific and practical knowledge, and our ability to produce useful products has been proven, the next priority for the AFRP is the establishment of new partnerships with governmental agencies, non-governmental organizations, research organizations, and private companies that share our goals and values, but are not yet involved in this effort.To achieve these large scale and long-term objectives, the AFRP seeks to establish an extensive network of associations, projects, seed and seedling producers, as well as communities and individuals committed to the restoration of this precious and highly threatened forest ecosystem. Indeed, much more remains to be done. The AFRP called a group of 80 restoration experts joined efforts to develop a monitoring protocol based on social, ecological, economical and management indicators, which is already available at the AFRP website. The protocol is being tested by several projects executed by the members and by the end of 2011 it is expected that major efforts to support restoration in the Atlantic Forest will be using the protocol to improve the quality and scale of those efforts.

CONCLUSION

Ecological restoration efforts must be integrated with stakeholders and a fully mobilized society at large in order to reach large scale. Messianic projects, not planned on the ground, will not succeed. The spirit of cooperation and mobilization of the Atlantic Forest Restoration Pact provide a template that could be adapted to other forest biomes in Brazil, and to other mega-diversity countries of the world.

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7. PLANNING FOR ECO-RESTORATION OF A WATER FOWL HABITAT – CASE STUDY OF SANTRAGACHI JHEEL, KOLKATA, INDIA

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Santragachi *Jheel* (lake) [88^{0}16'85"N to 88^{0}17'12" N and 22^{0}34'50" E to 22^{0}34'56" E], a fresh water aquatic system, is situated near the city Kolkata, India in a thoroughly built up environment. The *jheel*, spread over an area of 32 acres is flanked by a rail yard on one side and dwelling houses on the other. It serves as habitat for thousands of migratory birds. Several species of resident birds like White Breasted Water Hen, Little Cormorant, Indian Shag, Copper Smith Barbet etc. Also breed here. Among the common migratory birds spotted in the lake are Lesser Whistling Duck, Pintail, Gadwall, Shoveler, Garganey, Comb Duck, Common Mooorhen, Cotton Pygmy Goose and others. This water body also includes high diversity of aquatic fauna of indigenous fishes, insects and arachnids and a significant breeding and foraging ground of now locally endangered fish like predatory channa (*Channa marulius*).

During the recent past the lake suffered ecological degradation due to several causes like discharge of municipal effluents from the human settlement along the eastern periphery of the lake, discharge from a big Cow Shed and industrial effluents from the railway yard. The water quality parameter of the lake changed due to synergistic action of all the organic and inorganic pollutants draining into the lake elevating its TDS in the range of 34 mgl^{-1} to 1604 mgl^{-1}, conductivity in the range of 712 μscm^{-1} to 729 μscm^{-1}, total nitrogen in the range from 1.8-3.06 mgl^{-1}, Phosphorus from 0.06 mgl^{-1} to 0.73 mgl^{-1} , Potassium from 14 mgl^{-1} to 15 mgl^{-1} and D.O. from 1.9 mgl^{-1} to 10.2 mgl^{-1}. BOD, however, was low within the range of 1.4 mgl^{-1} to 4.5 mgl^{-1}. The sub-surface sediment also showed abnormal levels of nutrients with total nitrogen ranging from 176 $mgkg^{-1}$ to 1690 $mgkg^{-1}$and total Phosphorus in the range from 5915.11 mg kg^{-1} to 7606.69 $mgkg^{-1}$. The heavy metal contents in sediment were also high with Pb ranging from 22.83 $mgkg^{-1}$ to 133.53 $mgkg^{-1}$ and Cr ranging from 28.21 $mgkg^{-1}$ to 47.75 $mgkg^{-1}$.

The big water body is also used as a dumping ground of municipal solid waste at its south-western end. The landscape in the vicinity of the lake is also undergoing significant change as the value of the real estate has increased manifold in the recent years prompting new multi-storeyed buildings coming up in the area.

When all the parameters are taken together, the lake shows high level of nutrient as well as heavy metal level but relatively low in D.O. The condition of the lake can be described at best as marginal one for the life form inhabiting the aquatic area which may tip beyond the threshold in near future unless the situation is improved.

The vegetation of the lake can broadly be grouped into four communities – 1)*Brachiaria – Alternanthera – Eichhornia* Community 2)*Ceratophyllum – Hydrilla* submerged Community 3)*Pistia – Lemna- Spirodela* floating Community 4)Macrophytic mixed minor Community. The predominant species in this ecosystem are *Alternanthera philoxeroides, Brachiaria mutica* and *Eichhornia crassipes* which are also invasive species. The lake bank is encircled by vegetation comprising of shrubs and trees belonging to 29 species under 25 genera. They provide the shade and serve useful ecological role by secluding the lake from noisy neighbourhood. The lake suffers from under abundance of submerged macrophytes due to rapid infestation of floating macrophytes in the form of a thick mat on the water surface that lowers the photic depth of the aquatic body. The littoral faunal composition of the lake showed the species of 13 indigenous fishes, 12 aquatic insects, 9 molluscs, 3 Arachnids, 2 Crustaceans and 1 Annelid.

The plan for eco-restoration and their status of implementation is given below.

- The study identified that very high abundance of aquatic invasive species like *Brachiaria mutica, Eichhornia crassipes* & *Alternanthera philoxeroides* poses major threat to the water body by altering the water quality of the lake. However, some amount of gregarious floating macrophytes forming floating islands on the water surface is essential for the successful roosting place of the migratory birds. Therefore strategic removal of floating invasive species while maintaining the roosting site was planned for the *jheel*.
- **Status of implementation**: According to this plan every year about 70% of the floating weeds are removed from the lake in post-monsoon season. The remaining floating macrophytes are aggregated by confining them within floating bamboos to form artificial floating islands. Generally one big central island and a few smaller islands are prepared for roosting of water fowl.
- The huge inflow of swage from the human settlement as well as surface run off draining into the lake is main contributor in altering the bio-chemical character of the water body. While the study could not conduct the obvious effect of detergents coming through the domestic swage, it is felt that the undesirable effect may be observed in the long run. The remedial measures planned involve interception of the sewerage canals and treatment of effluents before discharge. Interception of the surface runoff and diversion of the flow has also been planned. However, this is relatively difficult to execute as the slope of surrounding areas is towards the *jheel*.
- **Status of implementation**: some of the waste water streams entering the lake have been intercepted and diverted. However, the majority of the sewage treatment work is yet to be undertaken.
- Treatment of industrial run off draining from the railway yard. This stream has very high content of oil and grease as well as some polycyclic hydrocarbons.
- **Status of implementation**: The matter of treatment was taken up with Indian Railways and they are in the process of addressing the problem.
- The large cow shed existed whose discharge was one of the major sources of BOD in the lake.
- **Status of implementation**: The cowshed has been shifted.
- Creation of alternate dumping site of municipal solid waste, infrastructure for sanitary landfill, awareness generation is some of the ways of addressing the problem of dumping MSW into the lake.
- **Status of implementation**: Large vats have been placed around the lake to serve as receptacle for MSW. Arrangement for disposal of the MSW collected in the vats has also been arranged. Other options will be implemented gradually
- Excavation and removal of lake sediment has been planned as an important eco restoration activity.
- **Status of implementation**: This is relatively expensive and may be taken up at a later stage.

8. ENHANCING ECOLOGICAL AND PEOPLE'S RESILIENCE: IMPLEMENTING THE CBD'S ECOSYSTEM APPROACH IN THE HINDU KUSH-HIMALAYAN REGION

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Keywords: biodiversity conservation, climate change, ecological integrity, ecosystem resilience, Hindu Kush-Himalayas

INTRODUCTION

The Hindu Kush-Himalayan Region (HKH), extends across the eight countries of Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal and Pakistan, and is a globally acknowledged biodiversity-rich area, represented in eight of the nine global conservation priority templates (Brooks et al. 2006). The services coming from the diverse ecosystem types cater to more than 200 million people in the region, and some 1.3 billion people in the downstream river basins. In the HKH, the ability of biodiversity to provide a diversity of goods and services has been influenced by synergistic impacts from a range of anthropogenic disturbances such as habitat degradation, habitat fragmentation, over-extraction of resources for economic benefits, and several other drivers of change such as land use cover change, climate change, globalisation, poverty, and demographic changes. Thus the task of biodiversity management with regard to enhancing the resilience of ecosystems and the wellbeing of people is becoming complex; and the conventional means of protecting biodiversity within the confines of protected areas (PAs) is constantly being challenged by rapidly degrading habitats outside PAs and even within some PAs.

IMPLEMENTING THE ECOSYSTEM APPROACH IN THE HKH

Biodiversity conservation is a national priority for all the eight countries sharing the HKH, and all are signatories to the Convention on Biological Diversity (CBD). As an immediate measure for protection of biodiversity in the HKH, the eight countries have together allocated more than 39% of their most biologically rich terrestrial lands into 488 PAs (Chettri et al. 2008). Over the years, biodiversity management in the HKH has advanced its focus towards integrated conservation approaches that safeguard ecosystem functions and services and respect people's dependence on the biodiversity for their livelihoods. The ecosystem approach endorsed by the sixth meeting of the Conference of Parties to the CBD is the type of management strategy that aims to synergise biodiversity conservation with sustainable utilisation for the benefit of people (CBD 2000). In the HKH, the CBD's ecosystem approach has been adopted to influence landscape-level regional (transboundary) biodiversity management (Sharma and Chettri 2005), which has led to the identification of east-west transboundary landscapes, and four north-south trans-Himalayan transects across the region as shown in Figure 1 (Chettri et al. 2009). These developments require managing ecosystems 'beyond borders', improvising upon a variety of existing biodiversity management interventions to enhance the ability of a larger landscape matrix and increase the resilience of ecological and human socioeconomic systems (Chettri et al. 2010). The ecosystem approach has also been the basis for development of corridors and connectivity, especially for restoring habitat contiguity between the mosaic of protected area habitats and allowing spatial flexibility for species distribution shifts along elevation gradients and horizontally (Chettri and Shakya 2010).

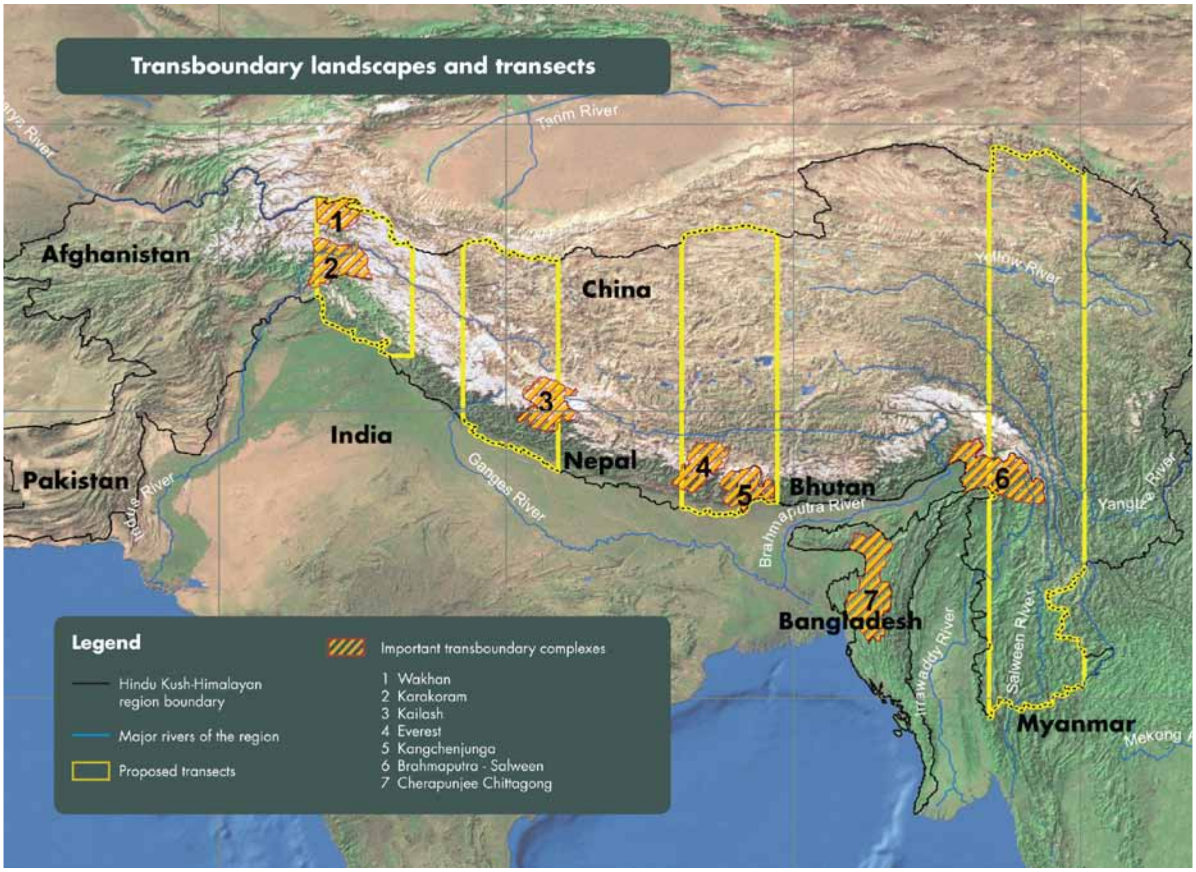

FIGURE 1: Six transboundary landscapes and four trans-Himalayan transects to facilitate the ecosystem approach in the HKH region.

RESTORING HABITATS TO ENHANCE ECOSYSTEM-BASED ADAPTATION

The ecosystem-based adaptation being promoted in the HKH through adoption of the ecosystem approach embodies the landscape-based solutions to reduce biodiversity vulnerabilities to climate change and other drivers by monitoring changes at larger scales, by managing a comprehensive representative reserve system, by developing connectivity between ecosystems, by restoring natural vegetation, and by benefiting people and building their socioeconomic resilience. It tends to consider both ecological and societal aspects of adaptation in a holistic way advancing both biodiversity and natural resource management and the socioeconomic adaptation for people. The ecosystem-based adaptation framework in the HKH emphasises adaptation as an interdisciplinary issue, and considers coordinated policy, management and capacity and knowledge development interventions at the landscape level as indicated in Figure 2. Ecosystem-based adaptation also provides a useful policy solution at the regional level bringing out synergies among climate change adaptation, biodiversity conservation and management, and sustainable development across the landscape (Sharma et al. 2010).

One of the prominent features of the ecosystem approach is the restoration of habitats outside the PAs so that both natural and managed ecosystems are brought within the biodiversity management framework, including agroforestry land, agricultural land, plantation forests, areas with wildlife corridors, and areas of cultural diversity, which maintain a significant genetic diversity. This integrated conservation approach has successfully advocated the establishment of habitat linkages or corridors among the scattered protected areas in the HKH region, not just to manage the contiguous ecosystem in its entirety, but also to support livelihoods of communities by involving people in the maintenance and use of the biodiversity resources in the corridor areas (Chettri and Shakya 2010). The multiple use habitats restored outside PAs in the form of conservation corridors provide an opportunity to establish well-functioning ecosystems across the landscape by interlinking PAs, by restoring degraded habitat outside PAs, by keeping the natural vegetation intact, by facilitating the movement and dispersal of many species of plants and animals, and by considering people's rights over the use of resources for their livelihoods. They also provide an opportunity to involve a multitude of institutions and people across the cultural and national fabric to promote biodiversity management across the larger landscape.

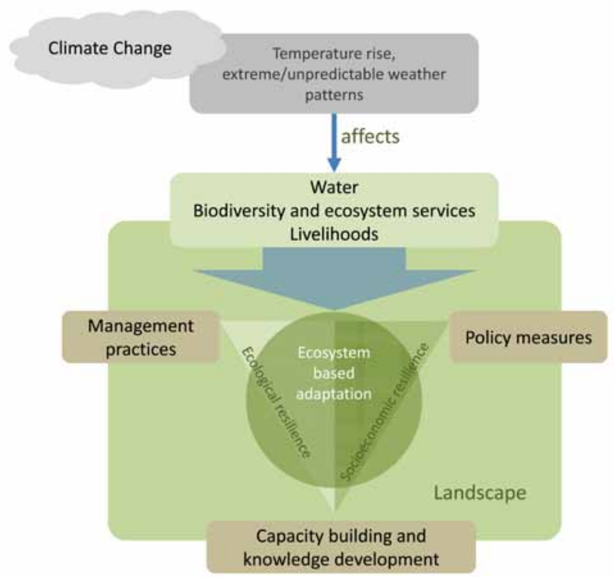

FIGURE 2: Schematic diagram to facilitate ecosystem based adaptation through implementation of the CBD's ecosystem approach at the landscape level

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9. RESTORING NEW ZEALAND'S URBAN ECOSYSTEMS

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Keywords: Urban Ecological Restoration New Zealand

INTRODUCTION

The islands of New Zealand have been isolated in the South Pacific for around 60 million years, resulting in a unique and highly endemic terrestrial flora and fauna. Recent human settlement (around 800 years ago) and the associated habitat destruction and exotic introductions have significantly disrupted many native ecosystems across the country. There are now approximately 2264 introduced species (comprising 30 mammals, 34 birds and 2200 plants) that are naturalised in terrestrial habitats and competing with, or predating upon New Zealand's indigenous species. The displacement of native flora and fauna by these introduced species is the primary challenge faced by conservation and restoration practitioners (Norton 2009).

Another key challenge in protecting our unique biodiversity is the landscape transformation and urbanisation of New Zealand. Some 86 percent of the population are urban dwellers and there is a highly fragmented pattern of urban and peri-urban indigenous habitats. The percent indigenous cover in New Zealand's 20 major urban centres (mean population: 118,764) ranges from <1 - 8 % (Clarkson et al. 2007). These disturbed ecosystems are often the last representations of depleted coastal and lowland ecosystems and are thus a priority for biodiversity protection.

Many community groups, research institutions, local and regional government agencies, iwi and private landowners are undertaking projects of different scales to remove invasive species and restore native ecosystems. At the University of Waikato's Environmental Research Institute (ERI) we provide sound ecological research directly applicable to these restoration projects. Our focus is on urban habitats because they provide unique and largely unrecognised opportunities: they allow intensive management with easy access and relatively small scales; large grazing animals are absent; there are significantly fewer mammalian predators than in New Zealand's non-urban systems; botanic gardens and zoos are readily available to facilitate the propagation and growth of threatened species; and there are large numbers of engaged volunteers.

The ERI's Ministry of Science and Innovation funded urban restoration research over the last six years has been undertaken in three North Island cities (Hamilton, Tauranga, and New Plymouth) with the goal of developing nationally-applicable templates for ecological restoration.

HAMILTON CITY

Hamilton City (population 171,600) has < 1% indigenous cover in the urban matrix. Our research aims to understand ecological processes in urban environments and how human impacts can be most efficiently reversed. Successional trajectories within the city have been determined through studies of the species composition and structure in a chronosequence of different aged restoration plantings. We have established the most cost effective methods for restoration planting and justified the use of a natural succession framework. We have also investigated the significance of seed rain and seed banks in urban environments and identified the requirements for native seed dominance and regeneration success.

We have worked alongside Hamilton City Council to plan and implement an ecosystem reconstruction in the 60 ha Waiwhakareke Natural Heritage Park (http://waiwhakareke.co.nz). This project acts as an on-going experiment to understand the most efficient methods for native ecosystem reconstruction. Planting of retired pasture land began in 2004 and to date, more than 15 ha have been planted to reconstruct four major forest types and two wetland types that represent the original diversity of the district.

We work with the Hamilton City Council to promote and resource the restoration of privately-owned forest patches in the city. The partnership has published a Gully Restoration Guide (www.gullyguide.co.nz) and regularly provides advice and guidance. We have also provided scientific advice in a cross-agency project to return native birds (tui *Prosthemadera novaeseelandiae; bellbird Anthornis melanura) to the city.*

A network of permanent vegetation plots has been established in indigenous urban forest remnants to provide a long term monitoring capacity. The plot design follows the i-Tree methodology to facilitate international comparisons. We have also trialled the City (Singapore) Biodiversity Index as a monitoring tool for measuring progress in relation to the Convention on Biological Diversity.

NEW PLYMOUTH CITY

New Plymouth City (population 68,901) has the advantage of 8 % indigenous cover in the urban matrix. We have been undertaking ecological research and providing restoration advice to local council and interested parties for the past 3 years. Key outcomes include restoration plans for urban coastal and riparian areas to increase local biodiversity and remove excess nutrients. The ERI is conducting pest animal profiling (along with Landcare Research), has installed permanent i-Tree monitoring plots, and held open educational workshops for residents. The urban New Plymouth environment has also provided a unique opportunity to study and intensively manage ecosystems that are under severe pressure in their natural range. This has included research into the management of naturally rare coastal turf communities with several nationally-listed threatened plants that have survived and can now be restored due to the lack of mammalian herbivores in the urban environment.

TAURANGA CITY

Tauranga City (population 103,632) has 1% of the built up area in indigenous cover. We have recently instigated research into the composition and structure of different aged urban restoration plantings throughout the city as well as the profiling of local pests to highlight the most efficient urban planting and pest management strategies.

CONCLUSION

Urban ecological restoration research at the ERI is dedicated to the conservation and restoration of biodiversity in New Zealand and thus contributes to the first objective of the Convention on Biological Diversity. Our work promotes the active repair and restoration of degraded environments. Urban ecological restoration contributes to human well-being when urban residents are engaged in local projects. Other benefits include environmental education, community cohesiveness, enhancement of ecosystem services, improved health and recreation opportunities and reconnection with nature. The unique restoration opportunities of urban systems provide potential for towns and cities to focus and drive ecological restoration at wider regional and national scales.

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10. AN INITIATIVE FOR ENHANCING THE BENEFITS TO ALL FORMS OF BIODIVERSITY AND ECOSYSTEM SERVICES IN THE ECONOMIC COOPERATION ORGANIZATION (ECO) REGION 1

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Keywords: Regional Planning, Strategic Planning, Regional Initiative, NBSAPs

BACKGROUND

Modern life has weakened the connections between humans and nature and the trend does not augur well for the sustainability of life on earth. Ever increasing rates of habitat and ecosystem degradation will result in the eventual non-existence of living organisms on earth, the only place where humans can live, as far as we know. The history of human interaction with nature demonstrates destructive consequences.

Concerns about the loss of biodiversity came to the attention of the international community in 1972, but it took 20 years before globally agreed terms of reference came into force as the Convention on Biological Diversity (CBD). Since then 192 parties have joined this convention and agreed to work together toward its objectives: the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising from the use of genetic resources, including appropriate access to genetic resources and appropriate transfer of relevant technologies which take into account all rights over those resources and technologies, and appropriate funding.

CBD changed protection priorities from species to ecosystems. This sounds feasible in principle, but the implementation of rules and regulations faces many challenges, mainly owing to technical and administrative inadequacies. CBD's approach to the conservation of biological resources and the sustainable use of its components (including the equitable sharing of its benefits) calls for inclusion of environmental concerns in all national and regional development policies. The Convention's latest development is a set of 20 targets to be considered as a global roadmap towards 2020.

Prior to the CBD, a regional agreement came into existence called the Economic Cooperation Organization (ECO), an intergovernmental regional organization established in 1985 by Iran, Pakistan and Turkey for the purpose of promoting economic, technical and cultural cooperation among the Member States. In 1992, the organization was expanded to include seven new members, namely: Islamic Republic of Afghanistan, Republic of Azerbaijan, Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan (Figure1).

The region is full of bright trading prospects. Despite its newness, ECO has developed into a thriving regional organization. Its international stature is growing. Nevertheless, the organization faces daunting challenges with respect to realization of its objectives and goals. Over the past 12 years the member states have been collaborating to accelerate the pace of regional development through their common endeavours. Besides shared cultural and historic affinities, they have been able to use the existing infrastructural and business links to further fortify their resolve to transfer their hopes and aspirations into a tangible reality.

1 ECO region includes ten countries: Afghanistan, Azerbaijan, Iran, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkey, Turkmenistan and Uzbekistan.

Most of ECO region countries have joined or ratified the international natural environment legal instruments such as the Convention on Biodiversity (CBD), United Nations Convention to Combat Desertification, the Convention on International Trade of Endangered Species (CITES), the World Heritage Convention (WHC), the Convention on Wetlands of International Importance (RAMSAR), Convention on Conservation of Migratory Species of Wild Animals (CMS), and so forth being considered as applicable tools for the protection and improvements of Asian natural environment and biodiversity.

FIGURE1. Map of the Eco region

Nevertheless, rapid population growth, industrialization, urbanization, increasing agricultural demands, droughts and other natural disasters and ineffective development policies are amongst factors fast degrading the natural resource base and influencing the state of the environment in the region and posing serious threats to sustainable development namely loss of biodiversity, pollution and depletion of freshwater resources, increasing threatened specie, mortality rates and contagious diseases, tourism pressures on protected areas, introduction of Alien Fauna and Flora, loss of genetic diversity, deforestation and loss of arable and grazing land, widespread land degradation and desertification. These have wider implications on food security, sustainable natural resources management, human health and efforts towards poverty alleviation.

Some studies show that several practices in the region have no ecological justification or economic rationale. Therefore improved and new conservation and management approaches are required.

PROPOSED INITIATIVE

To answer these complex needs, a regional initiative has been proposed to integrate National Biodiversity Strategies and Action Plans (NBSAPs) of all state members of the ECO region in order to develop a Regional Biodiversity Plan of Action (RBPA). This Plan will add to the framework plan of action on environmental cooperation and global warming for ECO member states (2011-2015) and could be used as a model for other neighbouring regions as well as other regional organizations and act as a roadmap for the implementation of CBD and achievement of Aichi Nagoya biodiversity targets. The initiative will be formally proposed by the ECO Institute of Environmental Science and Technology (ECO-IEST) to be developed under supervision of a Regional Steering Committee consisting of representatives of state members, academic centres and NGOs. It is expected that the results of such initiatives will feed into the NBSAPs to 'enhance the benefits to all forms of biodiversity and ecosystem services', particular with regard to target 14 of the Aichi Nagoya Targets: '*By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable*'.

Development of the RBAP would start with an initial assessment in the following stages:

- Geographical and land characteristics
- Protected Area systems and other in situ conservation
- Socio-economic situation including cultural, religious and traditional values
- Environmental legal systems
- Long-term development visions

The next phase of the initiative will be to establish coordination mechanisms of the RBPA. A monitoring framework also needs to be developed for tracking progress, effectiveness, and gaps in the Plan not only in the ECO region as a whole but also in each country as an important element in the big picture. A series of consultations, roundtables and workshops should be organized to discuss challenges and take appropriate decisions with regard to tackling barriers to the implementation of the Plan.

As the result of the development of RBAP many of the biodiversity challenges within the region will be identified and actions and programmes for their management will be defined. The benefits of developing Regional Biodiversity Action Plan is in accordance to the ECO plan of action and will be as indicated below:

- Conservation of Biodiversity
- Joint Efforts for Conservation of Transboundary Wetlands and Water Bodies
- Preservation, Management and Monitoring of Water basins and Resources
- Conducting Joint coherent actions on Endangered Species, Wildlife Migration Patterns, Mortality Rates, Contagious Diseases and International Trade
- Restriction on the Introduction of Alien Fauna and Flora
- Exchange of Biodiversity Museum Specimens and Biological Samples
- Combating Desertification, Deforestation, Land Erosion and Protection of Mountain Ecosystems

CONCLUSION

Although individual countries and not regions have mandatory tasks and obligations to undertake as members of the Convention, regional initiatives are required to facilitate synergies and sharing of experiences among countries with similar conditions and/or common interests. These arrangements would also benefit from inclusion of local communities in high-level decision-making fora.

Another benefit of the initiative would be enhanced co-ordination and cooperation between countries as well as stronger organizational and systematic capacities.

Existing institutional frameworks (such as ECO-IEST) will play a crucial role in this initiative not only during the development phase but also for implementation of the RBAP. It is also expected that this approach will bring coherence to national legal frameworks and facilities for the implementation of CBD.

There is no doubt that the initiative needs flexibility to be inclusive and able to work within the legal limitations of all state members. Public participation, cooperation mechanisms, decision-making support methods and a series of success indicators are substantial elements of such an initiative.

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11. TRANSFORMATION DU DIABLE EN ANGE EN VUE DE RESTAURER LES FONCTIONS DE L'ECOSYSTEME DU FLEUVE WOURI

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Mots clés : *jacinthe d'eau*, *papier*, *compost*, *wouri*

CONTEXTE ET JUSTIFICATION

La transformation du diable (jacinthe d'eau) en ange (produits utilisable) à travers le programme mangrove et jacinthe d'eau, initié en 2005 à Bonabérie au Cameroun par l'ONG Watershed Task Group (WTG) a reçu l'appui et le financement de la mairie de cette circonscription, IUCN, WWF-USA, et la société PECTEN Cameroon PLC. A présent, le Ministère de l'Environnement et de la Protection de la nature (MINEP) s'est également engagé et a mis en œuvre un grand projet de lutte contre la jacinthe d'eau dans sa stratégie nationale pour restaurer le fleuve Wouri.

Le diable que représente la jacinthe d'eau est une plante flottante aujourd'hui considérée comme le cancer des eaux. Elle a envahi l'estuaire du Wouri et d'autres fleuves tels que le Moungo et le Nyong au Cameroun. Sur une distance d'environ 209 km+, elle couvre environ 112,225 ha sur environ 14 290,57 ha d'eau sur le fleuve Wouri (http://www.wtgpartners.org/publications.htm).

La jacinthe d'eau pose de nombreux problèmes dans notre environnement. Ses racines denses et longues d'environ 30 cm envahissent la surface de l'eau et entrainent : une forte évapotranspiration ; la sédimentation ; l'eau devient plus chaude et pauvre en oxygène entrainant une modification de la biodiversité du milieu (flore et faune) ; la prolifération des moustiques ; les voies navigables sont obstruées et l'accès à de nombreux villages bloqué. Le Port Autonome de Douala dépense environ 5 milliards de FCFA par an pour le dragage. L'initiative d'enlèvement de la jacinthe d'eau contribuera à diminuer ces dépenses d'environ 20%. De nombreuses espèces de poissons et végétaux du milieu ont disparus. On observe l'installation de nouvelles espèces végétales telles que *Eichinochloa* sp, *Pennisetum pupureum* et *Polygonum* sp.

OBJECTIFS

L'objectif du programme est de lutter contre la prolifération de la jacinthe d'eau et assurer la restauration des fonctions du fleuve Wouri. Ceci conduit à la restauration de l'habitat pour le développement des espèces halieutiques, la préservation des niches des oiseaux d'eau ; la réduction de la prolifération des moustiques ; la restauration de l'aspect esthétique, touristique et récréationnel du milieu ; la régulation de la sédimentation pour améliorer le débit du fleuve et favoriser les activités hydroélectriques, hydro agricoles et portuaires en aval.

Selon les composantes de l'article 10 de la Convention sur la Diversité Biologique (CDB) relative à l'utilisation durable des éléments constitutifs de la diversité biologique, les activités ont consistées à : sensibiliser et informer la population riveraines sur les impacts de la jacinthe d'eau dans l'environnement ; transférer les compétences aux populations sur les techniques de récolte et valorisation de la jacinthe d'eau ; assurer l'implémentation de l'initiative au sein des communautés ; effectuer une analyse coût bénéfice de l'amélioration des fonctions de cet écosystème à travers ce programme de restauration.

RÉALISATIONS

L'idée de transformer le diable en ange passe par la récolte manuelle de la jacinthe d'eau et sa valorisation à travers la fabrication du papier, la production du compost et la réalisation des objets d'art (http://www.ouest.tv/news/1075/76/wari-05-08-2011:d.viewer.html). Les changements liés à l'extraction de la jacinthe d'eau du fleuve sont déjà visibles au niveau de la libération des criques de mangrove favorisant le développement des alevins ; l'ouverture des villages et des voies navigables ; la libération du lit du cours d'eau contribuant à rehausser le volet esthétique du milieu au niveau des berges. De nombreuses études se poursuivent quant à l'analyse de la composition physicochimique et biologique du milieu et la détermination du niveau de prolifération des espèces (poissons, crustacés, flore) après extraction de la jacinthe d'eau. Ainsi, ces différentes études nous permettront d'effectuer au fil des années une analyse coût et bénéfice de la restauration des différentes fonctions du fleuve Wouri.

FIGURE 1 : Situation de départ (obstruction des voies navigables, sédimentation…)

FIGURE 2 : Récolte de la jacinthe

FIGURE 3 : Papier obtenu après séchage du filtrat sur le tamis à soie

FIGURE 4 : Objets d'art réalisés avec la jacinthe d'eau par différents artiste

12. EU BIODIVERSITY STRATEGY: THE CONTRIBUTION OF GREEN INFRASTRUCTURE TOWARDS MEETING THE GLOBAL AND EUROPEAN UNION RESTORATION TARGETS

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Keywords: Biodiversity Strategy, European Union, Green Infrastructure, restoration

The European Union is fully committed to implement the Strategic Plan for Biodiversity 2011-2020 and its Aichi Targets adopted at the 10th Conference of the Parties in Nagoya in October 2010. In May 2011, the EU adopted a Biodiversity Strategy to 2020[1], which identifies 6 priority targets and 20 actions for the European Union with a view to contributing to collective global efforts to reach the global targets, and report thereon to the Conference of the Parties at its eleventh meeting.

The EU Biodiversity Strategy to 2020 builds on two strong mandates for action:

- The first mandate stems from global commitments which the EU signed up to at the biodiversity summit in Nagoya, Japan in October 2010. As a Party to the Convention on Biological Diversity, the EU is required to bring its biodiversity policy into line with its global commitments.
- The second mandate stems from European Heads of State, who agreed in 2010 on an EU 2050 vision and 2020 headline target for biodiversity. The EU headline target for 2020 requires that we do three things:
  - First, to halt the loss of biodiversity and the degradation of ecosystem services by 2020;
  - Second, to restore ecosystems where feasible (at least 15% of degraded ecosystems);
  - Third, to increase the EU's contribution to tackling the global biodiversity crisis.

With regards to ecosystem integrity, connectivity, resilience and restoration as addressed within Aichi targets 5, 11, 14 and 152, Target 2 of the EU Biodiversity Strategy is specifically promoting the implementation of Green Infrastructure and addressing restoration. The EU is committed to maintain and enhance ecosystems and their services by 2020, by establishing green infrastructure and restoring at least 15 % of degraded ecosystems. This target is a real challenge for the EU, which is the most fragmented continent, and has a long history of ecosystem modification and degradation, with only a marginal percentage of natural ecosystems left. The Strategy is also listing a series of actions that need to be implemented to achieve this ambitious target.

A major tool for EU to achieve this target will be the use of Green Infrastructure[3]. The EU is thus developing a Green Infrastructure Strategy by 2012.

Green infrastructure should serve the following purposes:

- to strengthen, and, where adequate, to restore the good functioning of ecosystems and ensure the multiple delivery of ecosystem services;

1 "Our life insurance, our natural capital: an EU biodiversity strategy to 2020" http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7[1].pdf
2 These targets result from previous COP decisions, notably UNEP/CBD/COP/X/ 33 on biodiversity and climate change and UNEP/CBD/COP/X/ 31 on Protected Areas
3 cf. action 6b of the EU Biodiversity strategy to 2020

- to contribute to enhance and conserve biodiversity by inter alia increasing spatial and functional connectivity between natural areas and improving landscape permeability and mitigating fragmentation (e.g. by ecological corridors, stepping stones, hub and buffer areas);
- to mitigate and adapt to climate change and
- to increase resilience and to reduce the vulnerability to natural disaster risks – floods, water scarcity and droughts, coastal erosion, forest fires, mudslides and avalanches – as well as urban heat islands;
- by making best use of the scarce land resources in Europe.

Green infrastructure can be considered a conceptual framework for understanding the "valuable services nature provides the human environment." At the national or subnational level, interconnected networks of protected areas, natural parks and wildlife corridors preserve ecological function and create a balance between built and natural environments. For example, to re-connect natural areas that have been cut up by roads, railways and urban sprawl, or to maintain healthy ecosystems and their services rather than building costly infrastructure like water purification plants.

At the city level, parks and urban forestry are central to reducing energy usage costs and creating clean, temperate air. Lastly, green roofs, walls, and other techniques within or on buildings bring a range of benefits, including reduced energy consumption and dramatically decreased storm water runoff. At all scales, Green Infrastructure provides real ecological, economic, and social benefits[4].

Protecting, managing and restoring biodiversity and ecosystem services provides multiple benefits to human society. These ecosystem-based approaches also contribute to societal climate change objectives by conserving or enhancing carbon stocks, reducing emissions caused by ecosystem degradation and loss, and providing cost-effective protection against some of the threats that result from climate change. For example, coastal ecosystems such as salt marshes and barrier beaches provide natural shoreline protection from storms and flooding, and urban green space cools cities (reducing the urban-heat island effect), minimises flooding and improves air quality. Such approaches provide multiple benefits, are cost-effective, ready now and likely to be more accessible to rural and poor communities. Thus they can align with and enhance poverty alleviation, resource efficiency and sustainable development strategies. There are also powerful economic and social arguments for taking action to protect biodiversity and ecosystems, and can attract substantial financial investments.

Green Infrastructure is using those ecosystem approaches, including integrated spatial planning, coastal habitat restoration, peatland restoration and catchment management, in order to maintain ecological functions at the landscape scale in combination with multi-functional land uses and contribute to ecosystem resilience. These approaches can be applied across a range of ecosystems, at all scales from local to continental and have the potential to reconcile short and long-term priorities. While contributing to halting the loss and degradation of biodiversity, they also enable the functions and services provided by ecosystems to provide a more cost-effective and sometimes more feasible adaptation solution than can be achieved by relying solely on conventional engineered infrastructure or technology-led measures. In addition, these approaches reduce the vulnerability of people and their livelihoods. They also help to maintain ecosystem services that are important for human well-being and vital to our ability to adapt to the effects of climate change.

4 Quote taken from American Society of landscape architects

13. APROVECHAMIENTO SUSTENTABLE DEL BOSQUE, REFORESTACIÓN POPULAR Y SU CONSOLIDACIÓN A TRAVÉS DE LOS PLANES DE ACCIÓN DE LA ESTRATEGIA NACIONAL DE DIVERSIDAD BIOLÓGICA 2010-2020.

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Palabras clave: estrategia nacional, plan de acción, aprovechamiento sustentable, restauración, bosque.

INTRODUCCIÓN

Venezuela es el décimo país con mayor diversidad biológica del mundo, con un 50,48% del territorio nacional cubierto por bosques. El aprovechamiento tanto de las especies del bosque como de los beneficios sociales que generan ha sido uno de los vínculos fundamentales entre el ser humano y el resto de la naturaleza, para nuestros pueblos indígenas, campesinos y aun para los habitantes de pueblos y ciudades, garantizando la soberanía y el desarrollo colectivo e individual de las generaciones presentes y futuras. Sin embargo, hoy en día los bosques también están siendo afectados por la gran crisis ambiental global, generada por el modelo de vida, producción y consumo capitalista, basado en la maximización de las ganancias, mercantilizando la naturaleza y los seres humanos, bajo una la lógica de progreso y crecimiento ilimitado, sin tomar en cuenta los límites del planeta. Este sistema ha generado hambre, violencia, miseria, ha masacrado y expulsado de sus territorios a pueblos indígenas, campesinos y campesinas, al apropiarse de sus tierras, bienes comunes, germoplasmas y conocimientos, causando entre otras cosas la desaparición de culturas ancestrales.

La República Bolivariana de Venezuela, como respuesta al modelo extractivo depredador de nuestros bosques, ha emprendido el retorno hacia la búsqueda de la armonía inicial y la soberanía, reorientando las políticas para su conservación desde la organización social para la conservación, el uso sustentable y la restauración. Tres grandes políticas, nacidas de la Revolución Bolivariana se articulan hoy para garantizar la conservación y el uso sustentable de nuestros bosques.

POLITICAS DE LA REVOLUCION BOLIVARIANA PARA LA CONSERVACIÓN DEL BOSQUE

La Misión Árbol surge como iniciativa del Gobierno Nacional, producto del Plan Sobremarcha dirigido por el Presidente de la República Hugo Chávez, inspirado en el decreto de Chuquisaca, dictado por El Libertador Simón Bolívar (1825), que le dio una importancia vital a la siembra de árboles para conservar los ríos. Su objetivo fundamental es contribuir a la recuperación y mantenimiento de los bosques en todo el territorio nacional, con la participación protagónica de las comunidades, mediante el establecimiento de sistemas protectores y agroforestales con fines conservacionistas, como estrategia de manejo integral y uso sustentable de las cuencas hidrográficas. La organización comunitaria se estructura en Comités Conservacionistas Comunitarios y Comités Conservacionistas Educativos. Desde su creación hasta la fecha, Misión Árbol Socialista está presente en todo el territorio nacional, ha beneficiado a 46.583 personas de manera directa, a conformado 4.542 comités conservacionistas, logrando establecer más de 42.568.393 millones de árboles y recuperando 34.761 hectáreas con la participación protagónica de las comunidades locales.

La recientemente creada Empresa Nacional Forestal surge como alternativa a las concesiones de explotación desmedida del bosque, con el objetivo de garantizar un esquema socialista de aprovechamiento sustentable de los bienes maderables y no maderables de los bosques del país. Presenta una visión integral desde el punto de vista ambiental, que busca no alterar las condiciones naturales en un grado tal que impliquen un riesgo para el mismo ecosistema. Esta tiene por objeto la producción sustentable de bienes y servicios forestales a través de la planificación y manejo del patrimonio forestal bajo una visión socialista, orientada a fortalecer la participación directa de las comunidades y organizaciones sociales en la producción, comercialización de bienes forestales maderables y no maderables y otros beneficios provenientes del bosque. Asimismo, la Empresa Nacional Forestal, tiene entre otras funciones, apoyar a la Autoridad Nacional Ambiental en el proceso de planificación, conservación, uso y manejo sustentable del patrimonio forestal; asociarse con otras organizaciones sociales y órganos del Estado bajo la denominación de empresas de propiedad social, para la ejecución de proyectos. Ejecuta programas de protección y vigilancia, y desarrolla proyectos orientados a la producción y siembra de especies forestales; además auspicia la conformación de redes productivas forestales que favorezcan las operaciones de generación, procesamiento, distribución y comercialización de sus bienes derivados.

La Estrategia Nacional para la Conservación de la Diversidad Biológica (ENCDB) 2010-2020 se orienta hacia la construcción del Socialismo del Siglo XXI a través de las directrices del Proyecto Nacional Simón Bolívar, primer Plan Socialista de Desarrollo Económico y Social de la Nación 2007-2013. Enmarcado en este Proyecto, la ENCDB está dirigida a impulsar una nueva ética ecosocialista a través de la conservación y uso sustentable de la Diversidad Biológica, como vía para alcanzar la Suprema Felicidad Social de las generaciones presentes y futuras. Esta estrategia busca abordar las amenazas sobre la diversidad biológica de manera sistémica y estructural, proponiendo siete líneas estratégicas y siete ejes transversales, como elementos técnicos y políticos necesarios para la conservación de la diversidad biológica. Esta Estrategia Nacional se potencia con la construcción colectiva del Plan de Acción Nacional y los Planes de Acción Local para la Conservación de la Diversidad Biológica, a través del cual se desarrollan las acciones específicas, indicadores, metas y actores que permiten la aplicación de la Estrategia a escala nacional o local.

CONCLUSIÓN

Los Planes de Acción de la estrategia surgen como un elemento aglutinador de las políticas de reforestación y aprovechamiento sustentable del bosque, en el sentido de que logra visualizar la conservación del bosque desde las siete líneas estratégicas y desde los siete ejes transversales, orientando soluciones globales y estructurales para palear un problema tan complejo como lo es la desaparición de los bosques, como una arista de la gran crisis ambiental que amenaza la vida en la tierra. Así desde los Planes de Acción, se logra la articulación con el proyecto de país, además de trascender la visión fragmentaria y se genera una mirada global e integrada de los problemas y las soluciones, y una relación armónica entre hombres y mujeres y naturaleza.

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14. ECOLOGICAL RESTORATION AND EXTINCTION PREVENTION: ERADICATING INVASIVE VERTEBRATES FROM ISLANDS TO HELP ACHIEVE CONVENTION ON BIOLOGICAL DIVERSITY 2020 TARGETS

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Keywords: Threatened species, preventing extinctions, invasive vertebrates, islands.

The eradication of invasive alien species (IAS) from islands has compelling biological, economic, and human health justification. IAS have been estimated to cost 5% of GDP globally (Pimental 2001). Approximately 80% of known species extinctions have taken place on islands, with IAS implicated as a primary cause (Atkins 1989, Ricketts et al. 2005). Species such as rodents and feral cats present risks to human health via diseases such as toxoplasmosis (Pyšek and Richardson 2010).

Removing Invasive Alien Vertebrates (IAV) from islands is a proven strategy to protect biodiversity and prevent extinctions of threatened species (Aguirre-Munoz et al. 2008). By removing the most damaging invasive vertebrates from islands – goats, pigs, rabbits, cats and rodents –Member Nations of the CBD have significant potential to help achieve the 2020 targets set forth in the strategic plan, including:

- *Target 5*: loss, degradation and fragmentation of natural habitats is at least halved.
- *Target 9*: invasive alien species are identified, prioritized and controlled or eradicated, and measures to control introduction pathways in place.
- *Target 12*: extinction and decline of threatened species is prevented and their status improved.

There have been over 700 successful eradications of invasive vertebrates worldwide (Keitt et al. 2011), and practitioners are undertaking removals from increasingly larger, more remote and more technically challenging islands each year (Howald et al. 2010), with the global pace of invasive species removal increasing (Phillips 2010). Importantly, greater collaborative outcomes are being sought to share resources and expertise, such as the 2011 joint expeditions to remove rodents from Palmyra Atoll, Henderson Island and Phoenix Islands.

An estimated 40% of IUCN critically endangered species inhabit islands (IUCN 2011). By eradicating IAV from islands, remarkable recoveries of endangered species can occur (Howald et al. 2007). Following removal of feral cats from Natividad Island, the Black-vented shearwater *Puffinus opisthomelas* showed dramatically reduced mortality (Kiett and Tershy 2003) and this species was subsequently down-listed by the IUCN from Vulnerable to Near Threatened. Following the removal of pacific rats from Table Island, New Caledonia, the IUCN Vulnerable Fairy Tern *Sterna nereis* recently nested there for the first time (Birdlife International 2011).

Non-native mammalian herbivory has proven to be particularly destructive to insular flora, resulting in species extinctions, increased erosion and alteration of vegetation structure and community (Coblentz 1978). To combat this threat in the Galapagos Islands, goats have been removed from 9 islands, and are currently being removed from another 3, totaling 719,410 ha (Carrion et al. 2011). In combination with removal of other noxious invasives, these efforts are preventing further degradation of natural habitat in this biologically rich archipelago, and help recover threatened species such as the Galapagos Rail (Donlan et al. 2007).

Efforts to eradicate IAV should be directed to islands and archipelagos that offer the greatest biodiversity benefits at the lowest cost. Prioritization of islands based on the number of threatened species, scope and severity of IAV threats, island attributes including human utilization are important considerations. Using resources such as the

IUCN Red List, the United Nations Environment Program Global Island Database, and the IUCN Invasive Species Specialist Group (ISSG) Global Invasives Database, Island Conservation and the UCSC Coastal Conservation Action Laboratory (CCAL) have begun a baseline review of insular breeding populations of IUCN Critically Endangered and Endangered mammals, amphibians, reptiles and birds of the world. Figure 1 shows an example of this dataset for the Southwest Pacific.

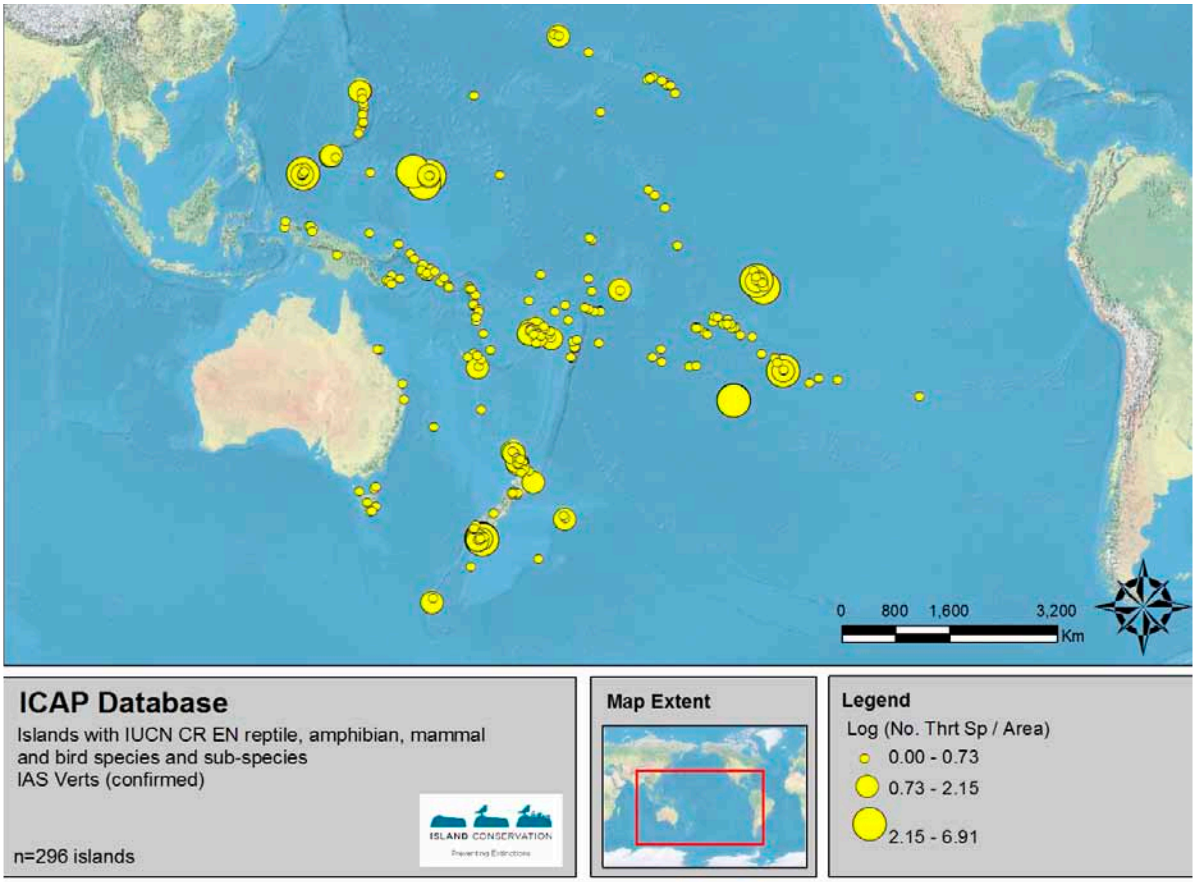

FIGURE 1: Islands of the Southwest pacific with breeding populations of IUCN Critically Endangered and Endangered birds, amphibians, reptiles and mammals, and invasive vertebrates. Points are scaled in size to represent the number of threatened species per unit area (expressed in log scale).

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15. INCENTIVIZING LOCAL COMMUNITIES TO MAINTAIN A HEALTHY MOUNTAIN ECOSYSTEM: AN EXAMPLE FROM A PILOT REDD PROJECT IN THREE WATERSHEDS OF NEPAL

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Keywords: regeneration and restoration, community forests, incentives, Nepal

INTRODUCTION

Forests provide valuable ecosystem services and goods, serve as a habitat for a wide range of flora and fauna, and hold a significant standing stock of global carbon. The total carbon content of forests was estimated to be 638 gigaton (Gt) in 2005, more than the amount of carbon in the entire atmosphere (UNFCCC 2011). Maintaining forest ecosystems in the mountains of the Hindu Kush-Himalayan (HKH) region is important for numerous reasons in addition to carbon sequestration. The HKH region is endowed with a rich gene pool and variety of species. It contains all or part of four Global Biodiversity Hotspots (Mittermeier et al. 2005); is home to several endangered species of global significance; houses 488 protected areas, 29 Ramsar Sites, 13 UNESCO Heritage Sites, and 330 Important Bird Areas (Chettri et al. 2008); and is the source and reservoir of water resources for downstream populations. Approximately 39% of the more than 4 million sq.km of the HKH region is managed under protected areas (Chettri et al. 2008; Pei 1995; Guangwei 2002).

In the past, governments relied on regulatory instruments to reduce deforestation and environmental degradation of the mountain forests, but these mechanisms have proven inadequate. Nepal, for example, has one of the highest deforestation rates among non-tropical countries (FAO 2003). There is an urgent need to reduce deforestation and degradation rates in the HKH region. Reducing Emissions from Deforestation and Forest Degradation (REDD+) is a useful policy option to provide incentives for local communities to maintain a healthy mountain ecosystem (Karky and Skutsch 2009), not only for upland populations, but even more important for lowland populations that depend on ecosystem services generated by the uplands.

A REDD pilot aimed at designing and setting up a governance and payment system for Nepal's community forests in three watersheds helped increase recognition of the role of community forests and ways to provide incentives to community forest managers (www.communityredd.com). The project witnessed an increase in standing carbon stock equivalent to 27,392 tonnes during the baseline year (2009–-2010). Though carbon is only one indicator for making payments, the spin-off benefits directly relate to biodiversity conservation. The project covered over 10,000 ha with a wide biodiversity managed by 105 community forest user groups (CFUGs). The sites have 16 floral species (Seebauer and Zomer unpublished) and the natural forest forms an important corridor-connectivity and habitat for biodiversity conservation outside the protected areas. The community carbon forestry approach is also recommended by the Green India Mission (GMI) 2011 policy which states that communities can be involved in monitoring carbon in community-managed forests.

Nepal's community forestry approach is a testament to communities' ability to restore degraded hillsides. Mountain landscapes need to be managed to enhance the capacity of natural sinks from both a climate perspective, and the local need for sustainable management. REDD+ revenue, whether through UNFCCC or incentives from the Convention on Biological Diversity (CBD) or the voluntary market, has a potential to act as an incentive to promote sustainable management and increase biodiversity conservation by reducing the risk from the threat of deforestation and degradation. Providing economic incentives to local communities is a key strategy for better management and sustainability of mountain ecosystems; the following describes one way of doing this.

FOREST CARBON TRUST FUND, REDD+ BENEFIT SHARING AND UTILISATION

A pilot Forest Carbon Trust Fund (FCTF) mechanism was developed through a wide level of consultation with national and local stakeholders. Its activities are aligned with the Forest Operational Plans (FOP) endorsed together by the District Forest Office (DFO) and CFUGs. This mechanism is responsible for monitoring and regulating forest management activities, validating the carbon stock data from the community, and paying claims based on the incremental forest carbon stock (Figure 1). Communities have formulated priority fund utilisation activities focusing on environmental and social safeguards (Box 1).

PRIORITY ACTIVITIES

- Activities that reduce deforestation
- Activities that reduce degradation including indirect activities such as use of alternative technologies
- Activities related to conservation of forest carbon stocks
- Sustainable management of forest and biodiversity conservation (as indicated by UNFCCC)
- Activities that enhance forest carbon stocks
- Poverty reduction/livelihood improvement activities
- Forest carbon monitoring
- Awareness raising and capacity building on REDD and climate change
- Auditing of FCTF and verification of carbon data

BOX 1: FCTF utilisation activities

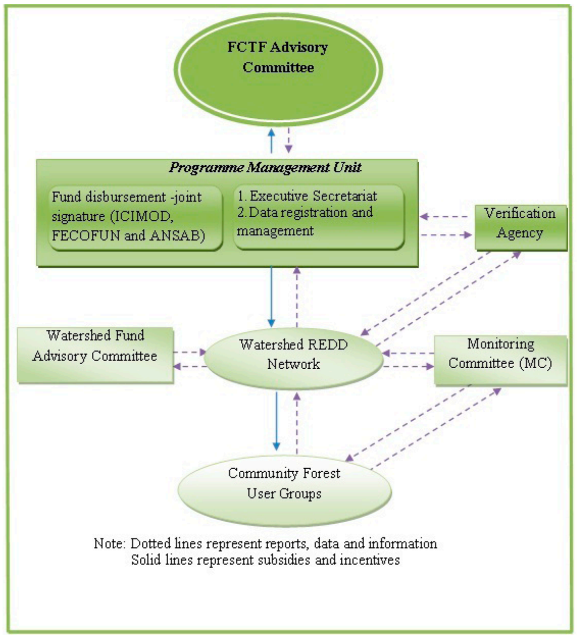

FIGURE 1: FCTF management structure

ISSUES AND CHALLENGES

Environmental valuation is difficult, and therefore most of the ecosystem services provided by forests are under-valued or not valued at all. Deforestation and forest degradation is a major threat which not only accelerates global carbon emissions but also increases biodiversity loss and species extinction. Carbon trading is a potentially useful approach but has high monitoring, reporting, and verification (MRV) and transaction costs. Small projects will not have sufficient economy of scale to cover these costs but may have better social and environmental sustainability impacts. An MRV system is needed that takes into account social (equity and rights) and environmental safeguards while implementing carbon offsets.

CONCLUSION

Carbon trading is a new concept globally and there is a need to build the capacity of local people who manage forests so that they can access carbon finance and benefit from it. Bundling of environmental services may help address proper valuation. This pilot REDD project with the FCTF is testing a governance system for REDD+, including a payment mechanism and compliance process. It will help demonstrate whether REDD payments to CFUGs will provide sufficient incentives for them to conserve and manage their forest better. The lessons learned from this pilot will help policy makers and planners to develop pro-poor and inclusive national-level policies for REDD+ payments in the future.

Forests not only play a role as global atmospheric carbon sinks and sources; they also provide other environmental services to upstream and downstream communities and are a storehouse of floral and faunal biodiversity. REDD has emerged as a performance-based incentive mechanism both for avoiding carbon emissions and for enhancing carbon stocks through use of sustainable forest management practices. The benefits associated with REDD would include direct payments for the standing forest, indirect income from employment, and non-monetary benefits such as improved environmental quality. The pilot REDD project addresses equity issues by combining performance criteria with socioeconomic criteria. There is a need to acknowledge the efforts provided by communities who manage and conserve their forest that provide a healthy mountain ecosystem, which benefits a wider population. Incentive mechanisms under REDD can be an integral part of ecosystem restoration and conservation of the fragile mountain landscape.

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16. AGRICULTURAL HERITAGE SYSTEMS: THE IMPORTANT ROLE IN REVITALIZING ECOSYSTEMS FOR BIODIVERSITY CONSERVATION AND SUSTAINABLE RURAL LIVELIHOODS

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Keywords: GIAHS, dynamic conservation, family farmers, co-adaptation

INTRODUCTION

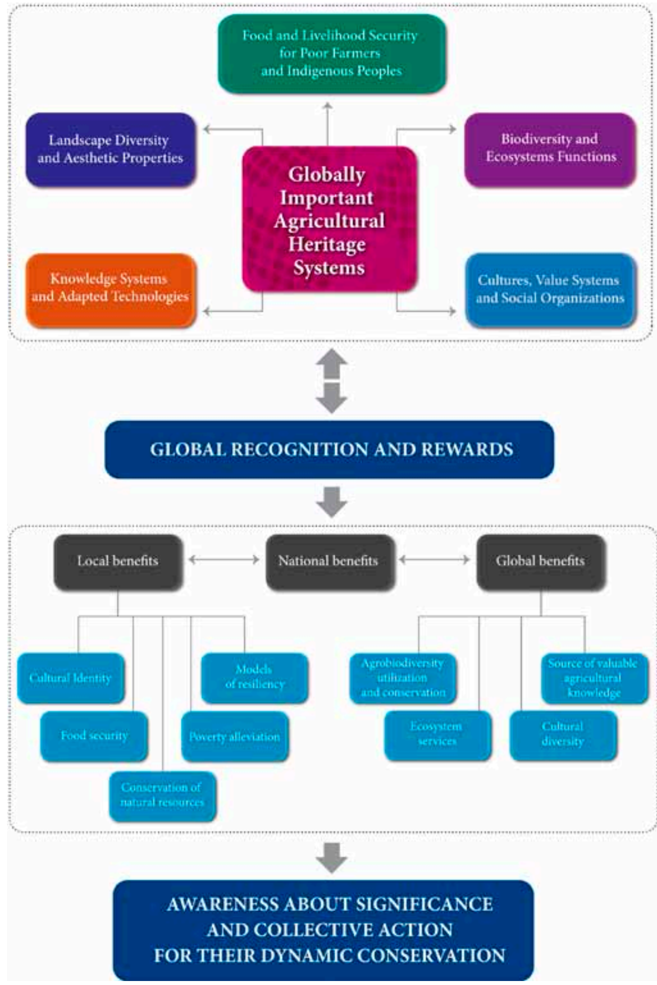
The stubborn persistence of millions of hectares under traditional farming is living proof of a successful indigenous agricultural strategy and is a tribute to the 'creativity' of small farmers throughout the developing world. Today, well into the first decade of the twenty-first century, throughout the world there are millions of smallholders, family farmers and indigenous people practicing resource-conserving farming. This is a testament to the remarkable resiliency of these agro-ecosystems in the face of continuous environmental and economic change. These systems continue to contribute substantially to the conservation of biodiversity and food security at local, regional and national levels. Many of these agro-ecosystems have unique attributes and goods and services, which would merit their being designated as Globally Important Agricultural Heritage Systems (GIAHS). Within this context, the Food and Agriculture Organization of the United Nations (FAO) has launched a global partnership on conservation and adaptive management of GIAHS. This partnership will identify and safeguard agricultural heritage systems and their associated landscapes, agricultural biodiversity and knowledge systems. This will be achieved by catalysing and establishing long-term programmes in support of such systems and by enhancing global national and local benefits derived that are from their dynamic conservation.

UNIQUE FEATURES AND PRINCIPLES OF GIAHS

GIAHS are remarkable land-use systems and landscapes that are rich in globally significant biological diversity, which has evolved as a result of the co-adaptation of a community with its environment and its needs and aspirations for sustainable development. Agricultural heritage landscapes are not only important landmarks having historical value, they also depend on living and evolving communities. These communities are the custodians of an institutional, ecological and cultural heritage that provides a variety of benefits and services at the local, national and global levels (Figure 1).

THE ROLE OF DYNAMIC CONSERVATION OF GIAHS

In China, dynamic conservation of traditional rice-fish agricultural heritage system has revitalized essential agro-ecological functions. Biodiversity conservation has improved the economic standing of small-scale farmers in Longxian village in Qingtian County by increasing farmer's income by more than 30 percent. These unexpected ecological and socio-economic benefits arise from the harmonious and symbiotic relationship of the rice-fish culture system, which has encouraged more provinces in China to conserve and invest in agricultural heritage systems. Inspired by this result, the local government of Qingtian County has developed a master conservation plan to support the upscaling of the GIAHS approach to generate ecological, economic and social benefits for the communities and for the sustainable management and health of ecosystem.



In Peru, from Macchupichu to Lake Titicaca, Andean communities are promoting sustainable agricultural heritage systems and revaluating traditional technologies for the management of soils, water and the environment. This has resulted in the in situ conservation of native potatoes, quinoa, kañiwa, arracacha, yacon, aguaymanto, capuli, sauco, and other plant and genetic resources of local and global significance. The social and customary institutions of the indigenous communities, and their better understanding of the nature-culture harmonious relationships, is sustaining the ecological approach to maintain this unique, culturally and biologically rich environment for future generations. The GIAHS approach has been incorporated in local government strategies, at the regional and national levels, especially for the conservation and use of agricultural biodiversity and agro-ecosystems management.

Oases farmers, in the Maghreb region in the extreme climate of Gafsa (Tunisia), El Oued (Algeria) and Imilchil (Morocco) are now better equipped to manage and revitalize their ecosystem diversity. They are supported by ingenious traditional, local resource-management institutions, that are not limited by the objective of food production, but view it as a way to manage and maintain the sustainablity of natural resources. GIAHS has introduced a multi-stakeholders participatory process to identify and assess the needs, aspirations and priorities of the oases communities. It has helped the communities identify, safeguard, and add economic value to the oases' agricultural patrimony in Gafsa, El Qued, and Imilchil, where biodiversity conservation has been revitalized.

These are few examples of the dynamic conservation of GIAHS in collaboration with family farming communities and indigenous peoples. More examples can be found at www.fao.or/nr/giahs. Over the last few years, the FAO–GIAHS initiative with its innovative, integrated and holistic approach has raised awareness, interest and enthusiasm in a wider audience both from local and international bodies. This has lead to a paradigm shift and policy change regarding small-holders, family farmers and indigenous communities. The initiative has made significant contributions to revitalizing ecosystems for biodiversity conservation and sustainable rural livelihoods of family farmers and indigenous communities at pilot sites in Asia, North Africa and Latin America.

SUMMARY AND WAY FORWARD

FAO's GIAHS initiative is an international partnership initiative that aims to identify and recognize unique traditional agricultural systems together with their agricultural biodiversity, culture and knowledge systems. The dynamic conservation of GIAHS is an innovative strategy to empower small-holder farmers, indigenous peoples and local communities, thus enhancing the local and global benefits derived from such systems for the benefit of humankind. GIAHS intends to continuously promote the: (i) recognition of the important role of local communities in maintaining GIAHS sites, participating in the decision-making process as well as deriving benefits arising from the services provided by the indigenous agricultural ecosystems; (ii) designing, development and deliverery of the means to enable local communities to benefit as stewards of GIAHS sites, through mechanisms such as payment for environmental services, rewards from ecotourism, and the marketing and certification of unique organic products; (iii) raising of awareness as to the importance of traditional agriculture locally, nationally and globally; and (iv) supporting sustainable development of GIAHS through promotion of on-the-ground projects and activities, enhancing capacities for maintaining, rebuilding and revitalizing agri-culture, promoting leadership, ownership, stewardship, and entrepreneurship across policy-makers, academic and research organizations, and local communities so as to scale up innovative ways to revitalize ecosystems for biodiversity conservation and for sustainable rural livelihoods.

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17. BRINGING BACK THE STEPPE: ADVANCING SUSTAINABILITY THROUGH GRASSLANDS RESTORATION IN UKRAINE

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Keywords: steppe, biodiversity, conservation, restoration, sustainability.

INTRODUCTION

Temperate grasslands – one of the most endangered ecosystems in the world – are drastically altered by human activities and yet poorly represented in protected areas. Grasslands occupy more of the earth's surface than the other major cover types, i.e. forests or agricultural lands. Along with this huge sweep of area, grasslands are an immensely important environment for humans, plants and animals. Globally, more people inhabit grasslands than any other biome (White et al. 2000).

FIGURE 1: *Askania-Nova Biosphere Reserve: The largest pristine steppe left in Ukraine (Kherson oblast).*

A long history of human use and abuse of grasslands has substantially shrunk their area around the world. The greatest loss of grasslands is in North America (Samson & Knopf 1994). On a European scale, grasslands are mostly of anthropogenic origin (Silva et al. 2008). Vast grasslands, that originally extended from south-east to central Europe, have been destroyed to a greater degree than any other type of vegetation. The last big "taming of the steppe" occurred about 200 years ago in Ukraine and nowadays about 82% of its steppe area is destroyed (Figure 1).

THE STEPPE IN TRANSFORMATION

The steppe occupied more than 40% of Ukraine in the past. Total destruction of steppe ecosystem started about two centuries ago when large-scale colonization began to exploit its natural resources. The high population density and availability of rich chernozems (black soils) induced a full-scale tilling of the steppe. The last large areas of steppe were plowed up during the Soviet Union kolkhoz (collective farm) campaign to expand food production in favour of annual crops. Nowadays, the steppe is almost completely ploughed up: therefore the virgin vegetation occurs almost exclusively on terraces of river valleys, steppe ravines, steep slopes, eroded lands, and military training grounds. However, even these steppe remnants might decrease in the process of privatization as well as under the impact of artificial forest plantation.

Such a significant steppe loss put them at the center of public interest and drew the attention of nature conservationists and scientists. Several nature reserves were established to protect representative variants of steppe vegetation. However, today only a handful of areas remain where natural steppe vegetation is found. Steppe communities occupy less than 3% of the country and steppe protected areas cover only about 1%.

CONSERVATION CHALLENGES

Whether the remnants of the steppe, even taken under protection, are capable of stable existence and recovery remains questionable. The ecological structure and function of the steppe ecosystem is damaged and its area is so small that the native vegetation can no longer successfully spread into nearby abandoned fields. The main threats currently facing the Ukrainian steppe are changes in land use, abandonment of traditional activities, loss of large-scale dynamic processes, and climate change (Heluta et al. 2002). Additional threats to the steppe are land privatization, afforestation, insufficient management practices in protected areas, and growing poverty of rural population. Issues such as habitat loss and fragmentation, native species decline and exotic species invasion, management use of grazing and fire are of common concern as well.

There is also a slow paradigm shift from traditional balanced nature protection to dynamic nature conservation among practitioners which is a significant barrier for introducing modern management in steppe conservation. To conserve steppe reserves, policies of absolute non-intervention should be abandoned. Managerial practices on steppe lands should be implemented to slow down succession and conserve biodiversity of the ecosystems.

RESTORATION OPPORTUNITIES

Despite the odds, there is a new ecological opportunity for the Ukrainian steppe after the end of Soviet-era kolkhoz farming. The collapse of socialism resulted in rapid and drastic changes in the political, societal and economic structures. This affected land use and the provision of ecosystem services in a profound way. During the last two decades, Ukraine gradually abolished large collective farms and divided up the land among the small landowners. Most productive land was quickly leased by big agribusiness companies. However, large areas of less productive farmland that once were pastures (some of them never were plowed) or croplands are now fallow.

FIGURE 2: *Restored steppe fragment in Donetsk Botanical Garden of the National Academy of Sciences of Ukraine.*

According to Charles (2010) there is a growing interest among farmers in Ukraine, particularly in Luhansk province, to bring back steppe through re-seeding of this abandoned land with native plant species, introducing grazing regime and raising of high-quality beef cattle. This will also assist in restoring a traditional Ukrainian cattle breed, known as Red Steppe, which survived in Askania-Nova Biosphere Reserve. In our opinion, establishing of regional learning centers to encourage farmers and environmental organizations to work together to reverse land degradation might be quite promising (Figure 2). These public and private lands can be managed using livestock as a tool to promote their recovery at low cost. They can sustain abundant wildlife and healthy rural communities once again.

ADVANCING SUSTAINABILITY

The Ukrainian steppe plant species and communities represent an outstanding and highly valuable part of world's natural heritage that needs efficient restoration efforts, particularly as many of the stands are threatened by land use and other changes. Considering the growing global demand on bioenergy, carbon sequestration, food, and importance of biodiversity conservation it is clear that the steppe of Ukraine should be one of focal regions of the world in this context.

Reducing the downward spiral of environmental degradation and biodiversity loss can be achieved through raising the public awareness, increasing local community participation, enhancing knowledge exchange, and ensuring partnership. These activities can help build not only ecological resilience of steppe ecosystems, but also increase overall human well-being in rural areas. If carefully managed and planned, sustainable development and biodiversity conservation can go hand in hand and reinforce each other.

The steppe of Ukraine represents a rich cultural legacy spanning almost eight millennia. It formed an important component of the modern nation's psyche. Due to the agricultural revolution on the steppe, Ukraine became the "breadbasket" of Europe. It is the current generation's task to rescue the steppe from degradation and save this treasure for the future.

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18. ANALYSES OF RECENT ECOSYSTEM DEGRADATION IN INDIAN REEFS TO PLANNING BIODIVERSITY RESTORATION FRAMEWORKS AND MONITORING

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ABSTRACT

All the four major coral reef areas in India are facing moderate to severe degradation. Though average live coral covers in the reefs of Gulf of Kachchh, Lakshadweep and Andaman Nicobar are 32.62 %, 28.9 %, and 50.49 % respectively – in the range of fair to good as per Gomez and Yap (1988) – signs of degradation are obvious by the equally high cover of algae or dead corals as the next dominating category. Gulf of Mannar reefs on the other hand have lost coral dominance with the live coral cover of 13.76 %, whereas algae and coral rubbles at 39.81 %, and 16.76 % covers respectively contributing the majority. Analysis of causes (of degradation) shows localized stressors playing a major role in spite of the impacts of periodic bleaching and other natural calamities.

In Gulf of Kachchh, despite the increase in coral cover since 2004, local stressors manipulating the reef status was apparent by the significant variation in values between reefs. Further, the high coral cover reefs were marked by low diversity indices and dominated by stress tolerant species. Continued sedimentation caused by felling of mangroves is major stressor in these reefs. In Lakshadweep, bleaching caused mortality (up to 26 %) in 1998, severely degraded the reefs which led to the brief algal dominance. Gains in coral cover (up to 19%) were observed 5 years after bleaching (Arthur, 2006). Monitoring observations from 2006 -10 showed steady increase in coral cover (20 – 28.9%) coupled with the decrease in algal (38 to 22 %) and bare substrate cover (32 to 23%). However, variation in recovery was observed between reef facies in these reefs, attributed to sewage seepage (cause of elevated nutrient levels) and siltation by the port activities, both of which favour algal growth and hinders recruitment and post-recruitment survivals. In Gulf of Mannar, bleaching caused mortality was severe (up to 82%,) in 1998 (Venkataraman, 2000). Futher degradation was observed with 16.2 % reduction in coral cover since 2003. Diversity indices were low ($H' = 1.07 \pm 0.21$) with 1 to 2 species dominating (% contribution >50) in reefs estimated with >20% live coral cover. Pressures of heavy resource exploitation, coupled with coastal pollution are the identified causes of degradation and impedance to recovery in these reefs. Andaman Nicobar reefs have not degraded over the years as per the status assessment. However, damages on account of reef up-lift (Earth-quake related) in North Andaman and tsunami onslaught in Nicobar island reefs in 2004, had caused reduction in live coral cover (41% and 55% less cover respectively for North Andaman and Nicobar), from the 2003 values (Rajan *et. al.*, 2008; Kulkarni *et. al.*, 2008; Saxena *et. al.*, 2008). Bleaching related mortality impacts were not apparent in the average live coral cover estimates in these reefs, however – shown by the diversity indices (low indices) – could impact diversity in reefs which experience continuous stress due to sediment onslaught.

Restoration in Indian reefs, based on the analyses above, at the first instance, should point to enhancing the depleted coral diversity (result of localized stressors) in turn to replenish other resources. In Gulf of Kachchh, the restoration plans should involve 1) rejuvenation of denuded mangroves at the fore reef intertidal expanses to effectively curb sedimentation to reef areas, and 2) monitoring industrial and sewage pollution. In Lakshadweep, and sewage treatment before discharge and regulated port activities to avoid excessive silation, are means to aid uniform reovery in different reef facies. In Gulf of Mannar, regulating heavy explotiation of resources and containing shore-based pollution could be achieved by 1) strict implemenation of the ban on trawlers in the buffer zone of the Biosphere Reserve and in lieu promoting artisnal fishing, 2) closing down fishing and other resources harvesting

in the core zone, and 3. identifying sources of pollution in to the reefs and advising for treatment before disposal. In Andaman and Nicobar, causes of erosion should be identified region-wise to stem sedimentation, which range from deforestation, farming, sand mining, and developmental activites in the coast. All the reef areas should be followed up with 1) monitoring studies on the diversity of recruiting scleracitinians and other associates, and 2) monitoring resources exploitation, in order to yield inputs in to active restoration measures if required.

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19. BUILDING RESILIENCE WHEN RESTORING DEGRADED ECOSYSTEMS: IMPROVING BIODIVERSITY VALUES AND SOCIO-ECONOMIC BENEFITS TO COMMUNITIES

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Keywords: ecological resilience, adaptive capacity, community-based restoration, ecosystem-based approaches, biodiversity, climate change

INTRODUCTION

There are several approaches used to address ecosystem degradation. One is to restore the degraded ecosystem to its historical state with regard to structure, function and composition. This option clearly helps improve the delivery of ecosystem services and the conservation of biodiversity. However, it is not always possible to restore an ecosystem to its historical state: environmental circumstances may have changed so that habitat conditions can no longer be re-established; some of the original species may have been lost; or exotic species cannot be removed. Ecological restoration may also be impossible for economic reasons, as landholders in many cases need to produce crops or other goods to provide for their families.

In situations where economic concerns prevail, a second approach commonly used to address degradation is to grow a commercially attractive species in a monoculture and use plant breeding, fertilisers and pesticides to maximise crop productivity. The advantage is that high levels of production can be achieved in the short-term, but the disadvantage is that monocultures can be exposed to serious ecological and economic risks. In many cases, these types of production systems can fail, and sometimes after a comparatively short period of time (Walker and Salt 2006). Although these systems are seemingly 'efficient', they are also fragile and vulnerable.

A third approach, and perhaps the most desirable, to addressing ecosystem degradation is to develop balanced strategies for restoring degraded lands that return some measure of structure and function while generating the goods/services landholders need to ensure their economic well-being, especially under climate change conditions. This approach avoids the costs associated with optimal productivity or impractical attempts to restore to historical conditions (Lamb 2011). It may be a way of allowing socio-ecological systems to better adapt to climate change and build much-needed resilience.

WHAT IS RESILIENCE?

Resilience is the capacity of a system to tolerate or adapt to disturbances while retaining, more or less, the same levels of structure, ecosystem functioning and feedback mechanisms. Healthy resilient ecosystems have a greater potential to mitigate and adapt to local and global changes; they are able to resist and recover from extreme events while continuing to provide vital ecosystem services. There are four components of resilience that should be taken into account when addressing degraded lands:

Ecological resilience is enhanced when a variety of species representing different functional types are used. These species can be present at a particular site or be represented in the surrounding landscape. The variety of species having different tolerances and capabilities means that ecosystem functioning is maintained even when environmental conditions change (such as during a drought, after a storm or following climate change). In addition, the importance of considering ecological resilience at a landscape scale is that it allows for species to recolonize areas where local extinctions have occurred.

Economic resilience is enhanced when there are a variety of goods and/or services produced to improve local livelihoods and to supply multiple markets. An economic system that produces a single good for sale to a single buyer has inherent risks and is characterized by a low level of resilience. Economic resilience can be enhanced by properly valuing ecosystem services and developing ways of payment for those services, including those for protected areas and local communities living in buffer zones or rural landscapes where the services are produced.

Social resilience is enhanced when land managers or communities are involved in creating and sharing knowledge, making decisions about land use, testing new species management and marketing systems and adaptive management and long-term monitoring frameworks. Less resilient systems are those where everything is top-down and landholders are dependent on outside advice and funding when responding to catastrophes or extreme events such as those resulting from climate change.

Institutional resilience is enhanced when there are polycentric or nested forms of governance and local institutions have technical, financial and legal support from regional and national bodies. Less resilient systems are those without vertical integration, that are inflexible and where all decision making is done by distant administrators unaware of what is actually happening on the ground.

TRANSLATING THEORY INTO PRACTICE

Building resilience is akin to taking out insurance against unforeseen changes in socio-economic and/or environmental conditions and makes intuitive sense. Nonetheless, it can be difficult to put into practice as it raises some fundamental questions:

- Just how much resilience is needed? How many species should be used in restoration?
- How should a landholder strike a balance between production and resilience?
- Are landscape patterns more important than what happens at a particular site?
- How does distance from a market determine the type of economic resilience possible?
- How do nations and communities develop supportive institutional structures?

Ecosystem-based approaches to enhancing adaptive capacity and reducing vulnerability offer the greatest hope for transforming degraded lands into productive ones that deliver multiple benefits to biodiversity and communities (Andrade et al 2010). Some proven examples of participatory ecological restoration integrated within an ecosystem-based approach include: (1) sustainable agro-forestry and livestock practices that increase species richness and water retention (resilience to droughts); (2) wetland, riparian and floodplain restoration in buffer zones (resilience to storms and floods); and (3) appropriate fire and species management in 'natural' forests (resilience to erosion, fire and pests). These approaches are often cost-effective and accessible to local rural communities, and could also be used to simultaneously improve livelihoods, generate sustainable development, contribute to increased carbon storage and promote its long-term stability.

CONCLUSION

There are a variety of ways to enhance ecosystem resilience, and the key is diversity, self-organization and functional redundancy in socio-ecological systems. Some of these approaches are capable of restoring ecosystem services and conserving biodiversity while also improving human livelihoods. Urgent attention must be given to developing strategies for restoring degraded ecosystems that improve their overall resilience if they are to persist within the increasingly uncertain ecological and economic environments of the future.

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20. LA ESTRATEGIA NACIONAL PARA LA CONSERVACIÓN DE LA DIVERSIDAD BIOLÓGICA DE LA REPÚBLICA BOLIVARIANA DE VENEZUELA (2010-2020) Y LA RESTAURACIÓN DE LOS ECOSISTEMAS

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Palabras clave: construcción colectiva, estrategia nacional, conservación, restauración, ecosistemas.

LA ESTRATEGIA NACIONAL PARA LA CONSERVACIÓN DE LA DIVERSIDAD BIOLÓGICA 2010-2020

En la República Bolivariana de Venezuela construimos colectivamente la Estrategia Nacional para la Conservación de la Diversidad Biológica 2010-2020, enmarcada en el Proyecto Nacional Simón Bolívar, primer Plan Socialista de Desarrollo Económico y Social de la Nación 2007-2013. Esta Estrategia se basa en una concepción humanista que promueve una relación diferente entre los seres humanos y la Madre Tierra, para impulsar un modelo de desarrollo alternativo fundamentado en la sustentabilidad ecológica, cultural, social y política.

La Estrategia Nacional para la Conservación de la Diversidad Biológica 2010-2020 fue construida con la participación simultánea de amplios sectores de la sociedad (académicos, servidores públicos, aficionados y organizaciones sociales de base), en numerosos talleres llevados a cabo durante 18 meses, los cuales permitieron la participación de más de 1600 personas a nivel nacional, promoviendo el debate y enriqueciendo el diagnóstico con diferentes puntos de vista. En una primera etapa se identificaron las principales causas de la pérdida de la Diversidad Biológica en tres escalas: causas próximas (aquellas que inciden directamente sobre la pérdida de la Diversidad Biológica), causas intermedias (aquellas que dan origen a las causas próximas) y causas estructurales (causas últimas vinculadas al modelo de desarrollo).

Como resultado del análisis del diagnóstico participativo de las amenazas de la Diversidad Biológica se establecieron siete Líneas Estratégicas, como elementos técnicos para abordar la situación actual de la pérdida de Diversidad Biológica. Estas líneas son:

1. Gestión de la información sobre Diversidad Biológica.
2. Conservación de especies amenazadas.
3. Áreas estratégicas para la conservación.
4. Aprovechamiento sustentable de la Diversidad Biológica.
5. Prevención, control y erradicación de especies exóticas.
6. Control y fiscalización de organismos genéticamente modificados.
7. Prevención y manejo del tráfico o comercio ilícito de especies.

Además, la Estrategia Nacional para la Conservación de la Diversidad Biológica incluye siete ejes transversales. Los mismos responden a principios establecidos en la Constitución, las Leyes y el Proyecto Nacional Simón Bolívar 2007-2013 y fueron identificados como elementos políticos y sociales necesarios para garantizar la conservación con compromiso social. De estos ejes transversales, los tres primeros tienen carácter de Principios fundamentales para garantizar la conservación con compromiso social en el marco de la construcción del Socialismo del siglo XXI. Estos ejes transversales se mencionan a continuación:

1. Ética ecosocialista.
2. Soberanía.
3. Inclusión y justicia social.
4. Educación para la conservación.
5. Legislación ambiental.
6. Gestión para la conservación.
7. Gestión y política internacional.

Este potente método de construcción colectiva de la Estrategia Nacional para la Conservación de la Diversidad Biológica 2010-2020 logró que los diferentes actores participantes, se involucraran en el proceso de construcción de políticas de Estado, generando una conciencia emergente mientras se transforma la realidad y *viceversa,* constituyendo un éxito para la implementación de la Estrategia y garantizando a priori el cumplimiento de las metas nacionales e internacionales para el decenio de la Diversidad Biológica de las Naciones Unidas.

La destrucción, degradación y fragmentación de ecosistemas fue identificada como una causa directa de la pérdida de Diversidad Biológica. Como respuesta a este problema se crea la línea estratégica 3, Áreas Estratégicas para la Conservación, la cual tiene como objetivo preservar y manejar espacios del territorio, cuyos elementos naturales los hacen estratégicos para la Nación, por los beneficios sociales que se derivan de su conservación y su contribución a la Suprema Felicidad Social perdurable. Esta línea tiene dos objetivos: 1) Garantizar la conservación del hábitat y los ecosistemas y 2) Diseñar e implementar programas de mitigación de impactos y restauración de ecosistemas degradados o fragmentados y fortalecer los ya existentes. Este segundo objetivo incluye desarrollar un diagnóstico nacional del estado de las Áreas Estratégicas para la Conservación, conocer el impacto de actividades potencialmente degradantes de los ecosistemas y revisar y diseñar planes de restauración y saneamiento de ecosistemas degradados.

CONCLUSION

Bajo la luz de la Estrategia Nacional para la Conservación de la Diversidad Biológica 2010-2020 los planes de restauración y saneamiento de ecosistemas degradados no se conciben de manera aislada, sino como parte de una estrategia integrada que entiende la conservación desde la integración de todas las líneas y los ejes de la Estrategia Nacional, resaltando los principios de ética ecosocialista, soberanía, inclusión y justicia social, única garantía de éxito de los planes de restauración.

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21. INDIGENOUS ECOSYSTEM-BASED ADAPTATION AND COMMUNITY-BASED ECOCULTURAL RESTORATION DURING RAPID CLIMATE DISRUPTION

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Keywords: Indigenous, Ecocultural restoration, Ecosystem-based adaptation, Western science, Climate change

Ecocultural restoration is the primary building block for ecosystem-based adaptation. It can be defined as: *The process of recovering as much as is recoverable of the key historic precontact ecosystem structure, composition, processes, and function, along with traditional, time-tested, ecologically appropriate and sustainable Indigenous cultural practices that helped shape ecosystems, while simultaneously building-in resilience to future rapid climate disruptions and other environmental changes in order to maintain ecological integrity in a way that ensures the survival of both Indigenous ecosystems and cultures*. "Ecocultural" restoration is distinguished from "ecological" restoration by its additional focus on culturally important species, while also taking care of the non-cultural communities (plant species assemblages or associations that contain one or more cultural species; and if ecologically degraded, will require restoration in order to maintain healthy cultural species) that the cultural plants (e.g. important food, medicine, basketry, etc. species) are associated with, and the use of traditional landcare practices, e.g. such as prescribed burning, selective harvesting, microsite-targeted agroecology, and agroforestry through selective cutting and replanting.

The foundational assumption of ecosystem-based adaptation is that the more of key pre-industrial landscape structure, composition and processes one can conceptually reconstruct, the more certain that ecological integrity— i.e. ecologically intact ecosystems with all the key components of structure, composition, and function in place—will be restored. [*Of course, some ecosystems have been so degraded or destroyed that this will be exceedingly difficult or impossible to do. Nevertheless, it is possible with many others.*] The more ecological integrity restored, the better able ecosystems will be to absorb and adapt to climate disruption—i.e., the more resilient to change. A key component of ecosystem-based adaptation is genetic diversity. Large and diverse gene pools are restored or maintained by ensuring maximum habitat heterogeneity across the landscape, providing sufficient microsites that could be both adaptation nurseries and climate refugia at the subspecies or population levels during further climate destabilization.

Existing ecological degradation will be exacerbated by climate disruption, which in turn will amplify both the effects of climate disruption as well as climate itself—a positive feedback loop that will reinforce and exponentially intensify all cumulative climate effects still further. If this progresses to a certain but still largely unknown point, irreversible thresholds may be crossed, causing ecosystems to flip to non-analog states outside of known historical ranges of variability.

What is too often left out of restoration planning is good baseline information about pre-industrial environmental conditions. We are not claiming that we can ever restore all of the complexity of ecosystems once they are gone. We *are* claiming that we should strive to recover as much of the key historic ecological elements of structure, composition, and function as are recoverable, removing barriers and setting trajectories that both autogenic processes and human interventions will continue over time. We are not attempting to set the historical clock back; rather we are re-setting the evolutionary clock—allowing evolutionary processes to operate at a rate sufficient for species to adapt to changing environmental conditions. We are balancing historical fidelity with ecological function, integrity, and resilience. *But our historical reconstruction work must be balanced with assisted species regeneration and enhancement in order to build in resilience. And assisted species regeneration will work best if maximum genetic diversity is ensured through the restoration of landscape heterogeneity—the maintenance or restoration of micro-sites where more climate adapted subspecies and populations can be in-situ nurseries for future propagation and climate refugia for future recolonization. That is, the restoration of climate refugial capacity will strengthen ecosystem-based adaptation. In focusing on generalized climate destabilization, we can easily forget the innumerable microsites available for adapted populations—sites that Indigenous caregivers know well.*

The field of historical ecology employs a variety of indirect or proxy and direct techniques to conceptually reconstruct historical reference ecosystems. Although our reference model will have to be modified by present changed conditions, the model will steer us in the right direction. We can avoid the phenomenon of "shifting baselines"—the proverbial "death by a thousand cuts"—the process over time of getting used to present environmental conditions and forgetting original longterm historical conditions with roughly the same historic climatic regime. The traditional landcare practices of Indigenous peoples, as keystone players in ecosystem dynamics and as an integral part of nature, cannot be left out of historical reconstructions. Indeed, advocates of non-analog creation totally leave out Indigenous peoples as do most mainstream restorationists. Indigenous peoples should be viewed as "alternative modernities"—as relevant to meeting today's climate and environmental challenges as any modern Western culture, and in many cases, probably more so. Adaptability and resilience define "Indigeneity". It defines traditional ecological knowledge (TEK) as well. Indigenous cultural practices and knowledge do not stand apart from restoration theory and practice; they need to be recognized as competent contributions to mainstream restoration.

Indigenous peoples are collaborating with Western researchers in the Arctic, northern Australia, Latin America, and other parts of the world. Indigenous peoples must have parity with Western scientists—mutual trust and respect—respect for Indigenous ethical protocols, intellectual property and knowledge. For Indigenous peoples, Western science can be a useful quantitative tool when it is needed or as a common language in cross-cultural communication. Indigenous TEK, on the other hand, can assist Western scientists who need to fill in sizable data gaps for local, often remote, places.

A growing minority of Western scientists over the past 15 or 20 years are beginning to realize the value of Indigenous TEK in assisting Western researchers who need to fill in large data gaps for local places. Observational approaches to data collection are now understood to be as important as experimental approaches. There are just too many environmental variables and too few researchers. Theoretical constructs based on limited numbers of experimental sites can be extrapolated out of proportion to observational verification. Local and traditional ecological knowledge based on qualitative observational approaches and Western experimental and quantitative approaches are being seen as *complementary*. As climate disruption continues to impact ecosystems and cultures at multiple spatial and temporal scales, observational data on sites that are not easily manipulated experimentally are becoming critically important. Without adequate observational data, there is a real possibility of climate disruption exacerbating already degraded ecosystems, causing them to cross thresholds well before we are aware of it happening. Indigenous and local experts can play an important role for both Western science and our present rapidly changing environment.

22. SEED BANKING FOR BIODIVERSE LANDSCAPE-SCALE RESTORATION

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Keywords: seed banking, restoration, seedling establishment, biodiversity conservation

INTRODUCTION

Since the realisation of the global extinction crisis in the 1980's, conservation seed banks of wild species have emerged as a powerful tool to protect species. However, *ex-situ* conservation measures such as seed banks should always be viewed as complementary to the preservation of species and habitats in the natural environment. The role that restoration plays in species conservation is increasingly recognised, with the Japan of the Conference of the Parties to the Convention on Biological Diversity (COP-10) highlighting ecological restoration as a significant opportunity for achieving global conservation goals (CBD 2010).

But restoration is facing a crisis of scale – how are biodiverse plant re-introductions to be achieved? Here we argue that effective use of native seeds underpins the achievement of these restoration targets and that seed banks need to shift focus from being 'stamp-collections' of species to collections that can deliver seeds at the tonne scale and larger (Merritt and Dixon 2011).

LANDSCAPE-SCALE RESTORATION REQUIRES SEEDS

Seeds are fundamental to large-scale restoration, being the only viable means of re-introducing plants at the 100 – 1000 km^2 scale. But the demand for seeds of wild species is a significant challenge to landscape-scale restoration. Many hundreds of tonnes of seed are required for restoration programs that span tens of thousands of hectares of degraded land. Current levels of seed wastage compound the problem, with more than 90% of seeds failing to produce an established seedling in most restoration programs (Merritt and Dixon 2011).

SEED BANKS CAN MAKE A DIFFERENCE

Seed banks can contribute the specialist knowledge in seed handling required to deliver restoration outcomes. However, the focus of conservation seed banks on capturing and storing species diversity as an insurance policy against extinction must be refocused towards supplying large volumes of restoration-ready seeds (Table 1). Restoration seed banks must address the commonly encountered shortfalls in seed knowledge that hamper restoration to achieve on-ground environmental and economic outcomes.

INTEGRATING SEED SCIENCE WITH RESTORATION PRACTICE

Seed supply
Most seeds used in restoration are collected from wild plant populations. Relying solely on wild collected seeds will increasingly result in supply shortfalls as the demands for seed increase to match the scale of restoration. Investment in large-scale seed farming enterprises, matched to genetic analysis tools to ensure provenance and hybridity issues are addressed, is critically needed to ensure supply and to reduce the impact of seed collection on wild sources.

Seed storage

Presently the storage of seeds for use in restoration is undertaken almost exclusively by end users – the commercial seed industry, mining companies, NGO's, and community-based groups. Storage facilities holding seeds for restoration are commonly low on technology, have limited access to knowledge and training in seed science, and limited capacity to problem solve (Table 1).

	INDUSTRY END-USER SEED BANK	CONSERVATION SEED BANK	RESTORATION SEED BANK
SCALE OF SEED COLLECTIONS	Small diversity, small volume	Large diversity, small volume	Large diversity, large volume
TECHNOLOGY	Low	Leading	Leading
ACCESSIBILITY	High	Medium	High
STORAGE DURATION	Short term	Long term	Short term and long term

TABLE 1: Restoration seed banking must move from low technology, end-user managed facilities. Adapting the operating principles of technologically advanced conservation seed banks and applying these principles at scale will ensure access to large volumes of high quality, restoration-ready seed.

Poor storage practices will result in reduced germination and weak seedlings unable to survive once re-introduced into a habitat. Correct handling and storage allows seeds to be banked over many seasons and allows practitioners to capitalise on high-seeding years (e.g. seed masting), providing a resource for large restoration projects. Careful control of the storage environment will ensure that seed viability is maintained. Flexibility in the available storage conditions is preferable, and seeds should be stored under conditions appropriate to their storage behaviour, dormancy type, and designated storage duration.

Seed dormancy release and germination requirements

Seed dormancy is present in around 70% of all angiosperms and represents one of the most challenging aspects to managing seeds. Many dominant plant families, particularly in biodiverse, seasonally dry biomes, have species with poorly understood germination requirements. Delivering dormant seeds to a restoration site may result in emergence failure. Seedlings may not emerge during the first growing season and seeds may then be lost to predation, erosion or viability loss. Developing reliable, repeatable, and scalable techniques for cueing seed germination on demand is fundamental to improving seed use.

Seed enhancement and seedling establishment

Poor seedling emergence is a major bottleneck in reducing seed wastage in restoration (James *et. al.* 2011). Across many biomes, commonly less than 10% of seeds sown in restoration sites germinate and result in an established plant (Merritt and Dixon 2011). Seedling establishment rates can be improved by correctly timing seed delivery to site, and simple treatments such as incorporation of seeds into the soil (Turner *et. al.* 2006). Seed enhancement treatments that can increase germination and establishment include priming, coating and pelleting. Such techniques are routinely applied in agricultural biotechnology, but are not yet widely adopted in the native seed industry.

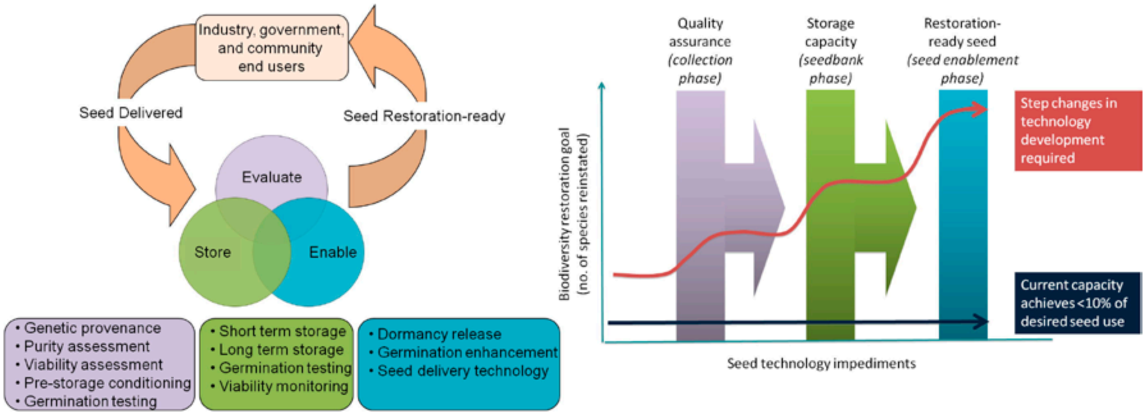

FIGURE 1: Integrated seed curation and research functions of a restoration seed bank. Seeds are delivered to centralised controlled environment storage facilities providing stringent seed assessment, curation, monitoring, and technology development functions (left). Investment in infrastructure and programs will address the step changes in technology capability required for delivering cost-effectiveness in landscape-scale restoration (right).

CONCLUSION

Restoration of all of the world's biomes requires seeds. The key to unlocking the global potential of restoration seed banks is the recognition that the unification of science-based seed knowledge with the infrastructure to support large-scale seed management applies to all seeds and ecosystems.

Seed bank policy-makers must now consider the scaling-up of seed banks to operational levels that are capable of sourcing and managing tonnes of seed to support landscape-scale restoration. A restoration seed bank must act as a hub for knowledge creation and innovation in native seed technology, integrating programs of science-based seed curation, research, and training (Figure 1). Developing effective working relationships with the restoration industry and the commercial seed industry is necessary to deliver the seed ecological knowledge generated to the "coal-face" of habitat repair.

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23. RAINFORESTATION: RESTORING PHILIPPINE FORESTS FOR COMMUNITIES, BIODIVERSITY AND ECOSYSTEM SERVICES

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Keywords: Rainforestation, native species reforestation, community-based forest management

INTRODUCTION

In the early twentieth century, more than 70 percent of the Philippines' total land area of 30 million hectares was covered by moist tropical rain forests of different ecosystem types. The most widespread forest ecosystem was the tropical lowland evergreen rainforest, dominated by the family Dipterocarpaceae, said to have covered about 20 million hectares. The vast expanse of forests across the archipelago nurtured a rich and unique biological diversity – one of the mega-diverse in the world. However, these dominant dipterocarps also fuelled the global market for wood products post-war. Rampant unsustainable timber extraction cleared huge tracts of forests giving way to agricultural, residential and other commercial uses. By the end of the century, the Philippines had only 18 percent of forest cover left, with less than a million hectares of old growth forests and 4 million hectares of naturally occurring residual forests in fragmented stands in inaccessible areas. Coupled with a rapid population growth and weak governance, the country has dramatically shifted from being a net wood exporter to being a net wood importer over just 5 decades, and has one of the lowest per capita forest cover in the tropics at about 0.085 (Guiang and Castillo 2005). Consequently, the Philippines is now considered as the "hottest of the hotspots" with its high level of endemic species steadily making its way to the IUCN Red List. Moreover, economic losses from disasters such as flash floods and landslides, top soil erosion, and siltation of coastal and marine resources continuously plague the country as it battles the root causes of deforestation and forest degradation.

The government initiated various reforestation programs starting in the 1960's evolving from purely government-initiated to community-based projects. However, lack of sustainability, conflicting government policies and instruments, and inequitable cost and benefit sharing, among others, led to a number of failed efforts. Furthermore, reforestation programs only used a handful of fast-growing exotic species which were promoted primarily for economic reasons, without any environmental consideration. These exotic monocultures were prone to pests and diseases, and did not do much for the restoration of native and endangered biodiversity or ecosystem services, like water, soil retention and disaster control. The extent and mechanisms of displacement of native species in areas planted to exotic species, as well as the surrounding intact areas, are also unknown. The practice of using exotics is even indirectly contributing to deforestation and the loss of biodiversity to some extent because, a) the fast growing exotics have low wood quality hence, high quality forest trees are still being harvested in their natural environment, b) the monocultures of exotic trees do not support the survival of local wildlife, which are important pollinators and dispersers of seeds, c) the fast growing exotics are all pioneer species with a short life span which support a management of repeated clear cutting, and d) native timber species, even if their quality is much higher than the exotic counterparts, are regarded lower in the market and are consequently only cut but not propagated. Ultimately, using exotic trees as reforestation species does not lead to the protection and preservation of the remaining natural forest (Margraf and Milan 1996).

FROM REFORESTATION TO RAINFORESTATION

In order to shed more light on the ecology and value of native species, and to halt the worsening situation with the use of exotic species, the Visayas State University (VSU, formerly Visayas State College of Agriculture) and the

German Agency for Technical Cooperation (GTZ) in the early 1990's developed an agro-forestry system known as "Rainforestation Farming" which uses native species to rehabilitate degraded landscapes, restore key ecosystem services and functions, while providing forest-dependent communities with an alternative source of livelihood. It has since evolved into "Rainforestation" with different typologies to cater to particular land use management objectives, including rehabilitation of landslide areas, critical watersheds, and denuded portions of protected areas, riverbank stabilization, habitat restoration, production areas, and urban greening. In fact, the national Department of Environment and Natural Resources (DENR) has adopted Rainforestation (RF) as the strategy in the development of open and denuded areas within protected areas and other appropriate forest lands in 2004, and as one of the official strategies in the 2011 National Greening Program, wherein 1.5 million hectares of public domain land will be reforested in the next 6 years.

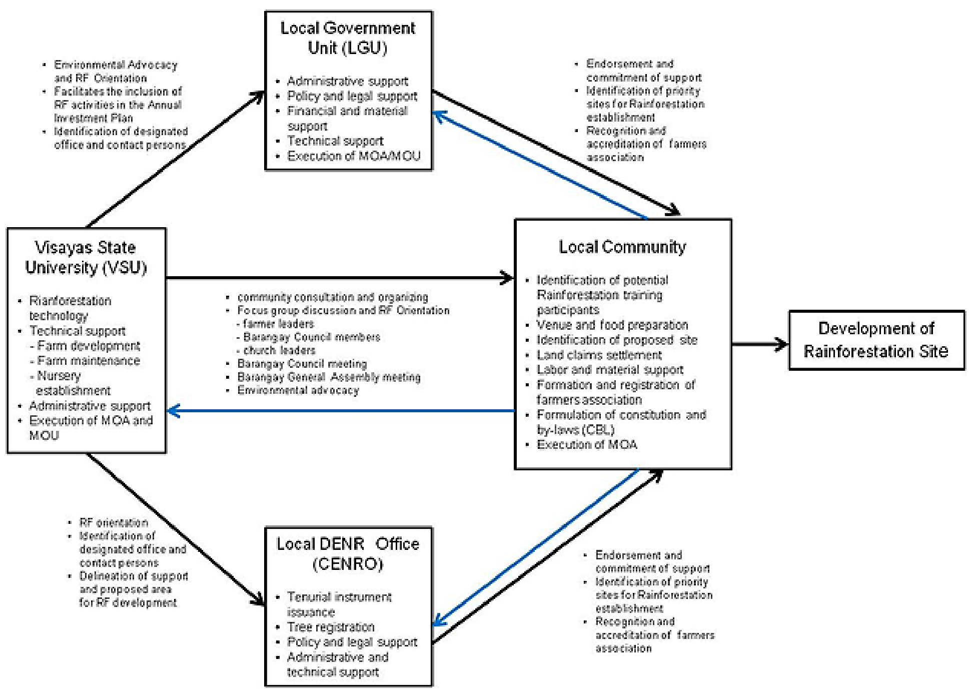

FIGURE 1: Rainforestation participatory approach.

RAINFORESTATION PRINCIPLES AND IMPLEMENTATION STRATEGIES

Rainforestation started out as a farming system that attempted to resemble as close as possible, the physical structure of a natural Philippine rainforest to efficiently recover its ecosystem function. Thus, the strategy utilizes trees indigenous to the area. Knowledge of the original forest type is, therefore, essential. Once the forest type and the other biophysical factors are considered, it is also crucial to identify the land use management objective. RF typologies were developed to classify implementing strategies based on biophysical suitability, purpose, land classification or tenurial instrument, and needs of the adopters/implementers. The approach recognizes the importance of the adopter's participation in all stages of the planning and strategy development and resource management. Figure 1 below illustrates the integration of the local academic/research institution, the local government unit, the local government agency (ie. local DENR), and the local community into the whole process. Here, local communities will be better enabled to practise sustainable forest management through a more synergistic relationship with the local government unit and agency. The latter will generally perform a facilitative role (technical, financial and administrative support, linkaging, and policy formulation) instead of the previous executive role. Non-government organizations are helpful in community empowerment through continued environmental education and related skills training such as non-timber forest product development, and finance and marketing plan development. Roles and responsibilities are clearly stipulated in a Memorandum of Understanding/Agreement to ensure that all parties are agreeable to the terms and conditions, and will follow through with their commitments.

Before implementing RF on the ground, the initial and specific site conditions of the target area are carefully analyzed in order to recommend the appropriate and optimal composition and distribution of tree species, as well as their timing of planting. Some biological considerations are the tree species' growth forms and habits, ie. light requirement of the seedlings for growth, shape of crown, generalist vs. specialist, etc., soil nutrient availability, water regime, competition and pest infestation. With all the biological and socio-economic factors taken into account, a farm/site plan will be developed accordingly.

The planting scheme follows the natural forest succession. During the first year, a mix of sun-demanding trees is planted at relatively close intervals – the distance depending on the typology. The canopy will close quickly, and the competition for light will favor a straight bole growth. Moreover, grasses will immediately be eradicated thereby drastically minimizing labor costs for maintenance. The high diversity mix will also reduce the risk of pest outbreaks.

In the second year, shade-tolerant trees are planted under the established pioneers. These trees include most of the critically endangered and highly valuable dipterocarp trees, fruit-bearing indigenous trees to attract seed dispersers and other wildlife, and in a RF farm or production typology, fruit trees such as mangosteen (Garcinia *mangostana*), durian (*Durio zibethinus*), lanzones (*Lansium domesticum*), to provide income to the farmer adopters. To further increase the productivity in a farm system, sun-demanding cash crops are planted between the trees during the first year then, shade-tolerant crops and ornamental plants are planted during the 2nd year.

The use of native forest tree species will guarantee a sustainable source of planting materials in forest restoration efforts in the country, while capitalizing on the indigenous knowledge of the communities in seedling production, and forest and biodiversity conservation. The supply of seedlings will provide another source of income for the communities, encouraging them all the more to protect the mother trees within their existing natural forests.

CONCLUSION

Although RF sites tend to be small-scale, they have successfully restored thousands of hectares of forest, provided the much needed habitat for the endemic and endangered biodiversity, and offered an alternative source of income to forest-dependent communities in the Philippines. To date, VSU and ELTI, together with its network of partners (Rain Forest Restoration Initiative, www.rainforestation.ph) continue to establish RF sites and nurseries all over the country, monitor the progress of these sites to ensure quality and sustainability, provide capacity building opportunities, and collaborate with the national and local governments, private sector and civil society organizations to scale up its advocacy, research and development, implementation and extension work.

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24. ROLE OF PRIVATE ENTERPRISE IN ECOLOGICAL RESTORATION OF SOUTH AFRICAN ECOSYSTEMS

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Keywords: Environmental Legislation, Ecological Restoration, Biodiversity Businesses, Natural Capital

The rapidly-growing population in South Africa is driving development of infrastructure, mineral and energy resources. Such development is a threat to biodiversity particularly in the bio-diverse arid and winter-rainfall regions of the country. Environmental legislation to minimize and mitigate damage is in place. Implementation of measures to ensure sustainability of development provides opportunities for private enterprise. This poster gives examples of ecological restoration projects tackled by private enterprise and private-public partnerships in South Africa, and discusses successes, failures and the challenges ahead.

ENVIRONMENTAL LEGISLATION

New environmental legislation introduced after the political change in South Africa (1994) has changed the way that mining and engineering companies deal with environmental issues, and particularly with restoration. The abandonment of mine dumps, pits and other disturbed natural landscapes is no longer an acceptable practice even in remote desert areas. The National Environmental Management Act (Act 107 of 1998) states that development should be socially, economically and environmentally sustainable and that disturbance of ecosystems and loss of biodiversity should be avoided or mitigated. Costs of remedying damage to the environment must be borne by those responsible for the damage. The Act is enforced by Provincial conservation agencies working in conjunction with national government departments that facilitate development (e.g. Department of Minerals and Energy, Department of Agriculture). In addition to making rehabilitation of natural ecosystems a legal requirement, the NEMA and the public participation processes required by the Act, served to raise public awareness of environmental issues and the potential role of ecological restoration in contributing to sustainable development. Together NEMA and growing environmental awareness have generated opportunities for private enterprise to contribute to the conservation of biological diversity and Restoration of Natural Capital for a healthier planet (Milton et al.2003; Aronson et al., 2007, Van Eeden et al. 2007).

AVISORY AND TRAINING SERVICES

In South Africa, private consultants are responsible for a wide range of activities that have potentially positive outcomes for biodiversity conservation and sustainability of ecosystem services. For example, they compile spatial development plans (including Critical Biodiversity Areas) for Municipalities (Berliner & Desmet 2007), assess potential environmental impacts and plan and oversee mitigation measures on behalf of mining and engineering companies, and carry out training of teams engaged in management activities that affect natural environments (Burke 2005; Carrick & Kruger 2007).

RUNOFF MANAGEMENT

In arid regions with high intensity rainfall, roads on inclines (even very gentle gradients) channel water, leading to soil erosion. All forms of landuse and development make use of roads. Many roads are badly placed from a hydrological, ecological or aesthetic point of view. Containment of erosion from roads and re-establishment of vegetation on old road surfaces requires mechanical ripping, reshaping of slopes, building of berms, gabions, culverts, erosion fencing and use of geotextile to reduce the rate of water movement and promote infiltration and vegetation establishment. This sector is labour intensive and provides opportunities for entrepreneurs with practical civil engineering and ecological management experience.

RESTORATION OF NATURAL VEGETATION

Challenges associated with restoration of exceptionally biodiverse and edaphically specialized natural vegetation under an arid climate include availability of propagules, low probability of favourable rainfall sequences, irreversible changes to soil structure and chemistry, and limited empirical knowledge about when and how to re-establish sustainable indigenous plant communities cost effectively.

Restoration of natural vegetation in South Africa is required at landscape scale following open-cast mining or overgrazing, or at smaller scales following power-line, road or building construction. Goals of revegetation with natural vegetation vary from restoration of ecological services such as forage production and dust control, to restoration of biodiversity and aesthetic values of natural landscape or generation of carbon credits (Mills & Cowling 2006). In the case of large mining and development projects the motivation for restoration of natural vegetation is generally legal compliance. Smaller-scale restoration projects in the farming, development and non-government conservation sectors may be motivated by personal goals that may be philosophical (e.g. desire to restore habitats, reintroduce endangered species and or restore natural beauty) or economic (e.g. beautification of scarred landscapes within sight of game lodges or reintroduction of plants with grazing value, attainment of green certification or image, or potential to generate carbon credits). Regardless of goals, all efforts to restore damaged vegetation to a near natural state or to rebuild habitats on cleared ground need specialist knowledge (consultants in plant ecology, agriculture and game management), as well as appropriate plant propagules (seeds, cuttings, plants), and a trained workforce to collect seeds or cuttings, propagate plants and implement the restoration work.

Partnerships between private enterprise, government, NGOs have driven some well-informed, sustainable, large-scale rehabilitation projects in South Africa. For example, ongoing restoration of the large succulent shrub *Portulacaria afra* (spekboom) to degraded rangeland in the Eastern Cape employs a large workforce that is currently supported by the government "Working for Woodlands" project and local and foreign NGOs. The project has potential to rebuild habitat for large and small indigenous wildlife as well as bringing back plants and scenery of cultural and economic significance (Mills & Cowling 2006). In the longer term it is probable that Carbon Credits will cover the costs of ongoing replanting of spekboom on some 10,000 ha (100 km^2). Restoration of natural vegetation on thousands of hectares of dunes and coastal vegetation on the eastern and western seaboards of South Africa that were damaged by open-cast titanium and diamond mines brought together university researchers, consultants and small businesses. At far smaller scales, some sectors of organized agriculture have achieved environmental certification for products from natural rangelands through collaborating with NGOs and private enterprise to set standards for environmental management or to repair damaged vegetation.

CONCLUSION

Partnerships between private enterprise, government and non-government organizations are needed to avoid and mitigate damage so as to maintain biodiversity and restore ecosystem services for future generations of South Africans.

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25. BOUNCING BACK FROM DISASTERS: REBUILDING SATOYAMA AND SATOUMI COMMUNITIES AFTER THE GREAT EAST JAPAN EARTHQUAKE AND TSUNAMI

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Keywords: earthquake and tsunami, restoration, resilience, revitalization of communities, International Partnership for the Satoyama Initiative

INTRODUCTION

The 9.0-magnitude earthquake and subsequent tsunami of 11 March 2011 caused untold destruction, and loss of lives and livelihood in northeastern Japan. Socio-ecological production landscapes (*satoyama* and *satoumi*) where people have traditionally lived in harmony with nature were among the affected areas. Despite what local people have been through, they are demonstrating strength and resilience in rebuilding their communities and livelihoods.

The International Partnership for the *Satoyama* Initiative (IPSI) co-organised the "*Great East Japan Earthquake Rebuilding Symposium: Exploring Integrative Approaches from Land to Sea*" with the Sustainable Ocean Initiative at the United Nations University Headquarters in Tokyo on 5 August 2011 to explore ways to support the efforts of local communities. Emphasis was on the importance and benefits from integrated approaches that take into account the linkages between land and sea, and the deep-rooted challenges these communities were already facing even before the disasters.

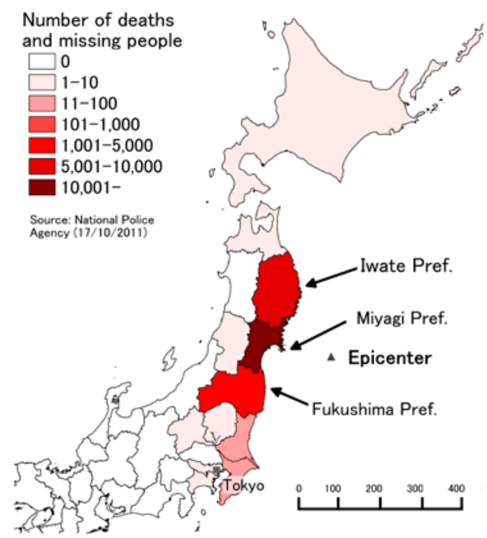

FIGURE 1: Almost 20,000 people died or are still missing, and nearly 300,000 houses were completely or partially destroyed (National Police Agency, 2011). <http://www.npa.go.jp/archive/keibi/biki/higaijokyo.pdf>

KEY FINDINGS OF THE SYMPOSIUM

1) Immediate challenges to restoration efforts led by those active in agriculture, forestry and fisheries: Different actors ranging from local leaders to scientists and policy advisors identified the following as the main immediate challenges in ongoing efforts towards rebuilding and restoring the region's core industries: agriculture, forestry and fisheries. These included the loss of current and future generations of successors, and the loss of means of production compounded by the large amounts of debris. Facing these challenges has provided opportunities to tackle deep-rooted problems faced by many satoyama and satoumi communities such as rural depopulation and ageing populations, which have contributed to a lack of successors.

2) Importance and potential of linking satoyama and satoumi in line with ecosystem-based approaches: Many terrestrial and wetland (marine and coastal) areas share both geographical and ecological linkages. From this perspective, tree planting has been undertaken by fishers in parts of Japan because forests and fresh-water springs are critical to ocean ecosystems. The objective of realising societies in harmony with nature is facilitated by 'green rebuilding' and 'integrated marine and coastal management', as well as integration into wider landscapes to increase ecosystem resilience rather than focusing on individual habitats or biomes. This harmony would be reinforced if ecosystem and human resilience are increased not only by applying adequate environmental conservation measures, but also by effectively dealing with nature's destructive forces as well as promoting human well-being and other benefits from ecosystem services.

3) Key issues for restoration and revitalisation of agriculture, forestry and fisheries: Biological and cultural diversity should not be sacrificed for the sake of rapid reconstruction. Also, efforts towards increasing productivity and efficiency should not be measured solely in economic terms. Satoyama and satoumi should be rebuilt without losing the unique traditions and culture of local communities, while exploring forward-looking relationships between elders and young successors, as well as fostering linkages with the wider society. It is important to develop new ideas and explore new values while learning from the past, including new forms of co-management systems (e.g. new coalitions among fishers beyond the framework of conventional cooperatives). For farmers and fishers who have been relatively disconnected from consumers due to the conventional supply chain, modern technologies and social networking, such as facebook and twitter, could help facilitate communication with wider audiences.

4) Ensuring the engagement of different stakeholders in supporting restoration processes: The bottom-up, participatory and multi-stakeholder approaches to reconstruction are important, as well as the role of scientists, particularly the need for clear scientific risk and disaster assessments in order to regain public trust. Local communities need to show leadership in taking initiative, and bureaucratic sectionalism needs to be reformed so that policies can reflect the voices of local communities. Linking agriculture, forestry and fisheries, as well as the commercial and tourism sectors, will not only aid sustainable production and use of local resources, but also revitalise local communities during the rebuilding process. Consumers can also play a major role in supporting restoration efforts, for example, by purchasing local goods that are produced in an environmentally friendly manner.

5) Collecting lessons from the restoration process and disseminating them in Japan and abroad: While earthquakes and tsunamis are largely unpredictable, they do occur at rather regular intervals around the world. Thus relevant knowledge and lessons should be collected and shared. The Great East Japan Earthquake and subsequent tsunami, just like past earthquakes in Sumatra, Indonesia (2004) and Maule, Chile (2010), is providing the world with important lessons in terms of future disaster preparedness and adaptation. It has also drawn attention to both new and longstanding challenges and opportunities. In addition, the recent experiences in Japan serve as an important model for regional recovery based on the restoration and revitalisation of satoyama and satoumi, with IPSI providing a useful platform for collecting and sharing such information.

WAY FORWARD

There are opportunities for partners of the *Satoyama* Initiative, with its vision of realising societies in harmony with nature, to potentially contribute in a meaningful way to the rebuilding efforts across northeastern Japan. By organising the August 2011 symposium, IPSI has taken first steps towards supporting local communities, by providing them a platform to share their knowledge and experience. Moving forward from this starting point, IPSI is planning to facilitate discussions towards concrete actions in line with relevant global initiatives, such as the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets, in particular targets 11, 14 and 15, as well as plans and strategies of other biodiversity-related MEAs such as Resolution VIII.16 (Principles and guidelines for wetland restoration) of the Ramsar Convention.

WHAT ARE *SATOYAMA* AND *SATOUMI*?

Satoyama landscapes comprise a mosaic of different terrestrial-aquatic ecosystems, including secondary forests, farm lands, irrigation ponds, and grasslands, along with human settlements. Similarly, *satoumi* refers to landscape mosaics consisting of different marine coastal ecosystems, such as beaches, rocky shores, tidal flats and sea grass beds. These landscapes exist not only in Japan but also in countries around the world, where they are known by a variety of different names. They provide various ecosystem services supported by relatively high levels of biodiversity. The *Satoyama* Initiative uses the term "socio-ecological production landscapes" (SEPLs) to describe these dynamic mosaics of habitats and land uses that have been shaped over the years by the interactions between people and nature in ways that maintain biodiversity and provide humans with goods and services for their well-being.

FIGURE 2: A 200 year-old pine tree stands alone on the coastline. In the wake of the tsunami, it is the sole survivor of a pine tree forest that once held 70,000 trees.

AKANE MINOHARA

FIGURE 3: A festival brings new hope to a community as fishers in the island carry a portable shrine through the rubble.

26. LOCAL-LEVEL SOLUTIONS TO LANDSCAPE RESTORATION CHALLENGES: BEST PRACTICES FOR BIODIVERSITY CONSERVATION THROUGH MODEL FOREST PARTNERSHIPS

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Keywords: landscapes, partnerships, sustainability, restoration, networking, Model Forest, Africa, Asia, Latin America, Canada

INTRODUCTION

Traditional approaches to biodiversity restoration have often focused on measurable biophysical outcomes. However, for nearly 20 years the Model Forest approach to biodiversity restoration has also been addressing the social and economic dimensions of these challenges.

A Model Forest is a place, a partnership and a process. The place is a landscape or ecosystem-scale area; the partnership is voluntary and inclusive, from national policy makers to academics to local farmers; and the process is a long-term dialogue involving research and the exploration of innovative approaches to understand what "sustainability" means within a given landscape, the trade-offs involved, and how to use the partnership to work toward collectively defined sustainability goals.

The International Model Forest Network (IMFN) is made up of 55 Model Forests operating in 30 countries with a cumulative area of about 110,000,000 hectares. To better address regional issues and priorities regional Model Forest networks have been established in Canada, Latin America, Africa, Asia and the Mediterranean, with Model Forests in Sweden and Russia as well.

By operating as a network lessons learned can be easily shared with others thereby accelerating progress towards sustainability. Importantly, the approach responds to local needs and is country-driven.

PARTNERSHIP IS KEY

Partners in the **Ulot Watershed Model Forest (Philippines)** include forest owners, indigenous peoples, local communities, NGOs, a local mining company and the United Nations' Development Program (UNDP). The focus of the partnership is on the rehabilitation of mined-out areas, the reduction of soil erosion, the renewal of forest resources, and increased local incomes from the responsible use of forest resources.

Restoration and biodiversity conservation drivers are also found in **Kodagu Model Forest (India)** on the western side of the Indian subcontinent, within the Western Ghats mountain range in Karnataka State. This region is considered one of the most diverse ecosystems in the world and one of "hottest hot spots" of biodiversity. A major initiative to restore degraded sacred groves in Kodagu has led to an increased understanding of roles and responsibilities regarding sustainable resource management at the community level.

In eastern Canada, the **Nova Forest Alliance** (a Model Forest) in central Nova Scotia and **Fundy Model Forest** in New Brunswick are part of the Acadian forest region. The Acadian forest is a unique, diverse ecosystem found only in eastern North America. Excessive clearcutting and degradation of forest stands is a serious problem. Work by both Model Forests encompasses different aspects of biodiversity restoration. For example, working in close cooperation with local forest industry, landowners and university partners, the Nova Forest Alliance has a strong environmental focus on hardwood forest recovery, watershed planning and natural disturbance regimes.

COMMON INTERESTS LEAD TO COOPERATION

Throughout the IMFN, Model Forests pursue joint projects and training, identify collaborative opportunities and secure political support to enhance prospects for effective site-level activity. For example, from 2008 to 2010 a joint project focusing on biodiversity restoration and community development was undertaken with participation from the **Colinas Bajas Model Forest** in Dominican Republic, the **Atlántida Model Forest** in Honduras, and the **Reventazón Model Forest** in Costa Rica. While proactively maintaining a functioning native tree-dominated ecosystem, rural communities benefited socially and economically through activities that included planting and harvesting of commercial agro-forestry products.

Aboriginal stakeholders are active participants in the **Prince Albert Model Forest (Canada)** and include representatives of the Lac La Ronge Indian Band, Montreal Lake Cree nation, the Prince Albert Grand Council and the Federation of Saskatchewan Indian Nations. This Model Forest partnership is sharing experiences of Aboriginal perspectives on land restoration and management with **Vilhelmina Model Forest** in Sweden as well as the **Araucaria del Alto Malleco Model Forest** in Chile.

New Model Forests are being developed in Morocco, Tunisia and several other countries of the Mediterranean basin. Some of the major issues to be addressed will be drought, poor water management and intensive land use leading to impoverished soils and degraded woodlands.

While in Africa, the Government of Rwanda recently announced its new Forest Landscape Restoration Initiative – a highly ambitious, comprehensive national plan to restore forests, land, soil and water over the next 25 years. The African Model Forest Network, with support from the Canadian government and the IMFN, is working with the Government of Rwanda to identify and support Model Forest development on a priority landscape in Rwanda. The IMFN is well positioned to tap into the rich experience of its partners around the world in support of forest stewardship for this initiative.

CONCLUSIONS

Model Forests are strategic platforms for ecosystem-based management that connect a wide range of stakeholders over large landscapes, and can develop and implement applied research and test innovative solutions. The partnership structures of Model Forests and networking at different levels can provide insights and tangible solutions to addressing biodiversity benefits for forests and local communities.

Model Forests demonstrate that small-scale solutions to large national- or international-level concerns can make a difference. Increased collaboration among IMFN members, as well as with other organizations with similar goals, will help address issues such as climate change, biodiversity, land degradation and poverty alleviation.

27. IMPACT OF REHABILITATED SITES ON HERBIVORE DYNAMICS IN A LIVESTOCK-WILDLIFE INTERFACE IN LAIKIPIA, KENYA

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Keywords: Community conservation, Livestock, Pastoralism, Range rehabilitation, Wildlife

INTRODUCTION

Habitat loss and degradation is one of the leading causes of declining wildlife numbers inside as well as outside African parks (Western et al., 2009). In East Africa, an estimated 70 % of wildlife populations are dispersed outside protected areas (PAs) on community pastoral land. The presence of unfenced and uncultivated rangelands adjacent to the protected areas increases the total range of resources available to wildlife and enhances long-term survival as predicted by the island bio-geographic theory (Western and Ssemakula, 1981). Conservation of the region's migratory wildlife populations largely depends on maintaining these habitats on communally owned lands (Henson et al., 2009). However, the rate of land degradation in community land is extremely high, presenting a growing need to promote ecosystem-wide and integrated landscape practices that combine livestock production and community-based conservation measures. Range rehabilitation was carried out in degraded grazing areas in three community ranches in Laikipia to improve grazing resources and create alternative income generating activities. This study was carried out after repeated observation of surprisingly high aggregation of wild herbivores in the rehabilitated sites. The aims were to: (1) determine whether large herbivore use of rehabilitated sites differs from the non-intervention background areas and, (2) examine how spatial distribution of herbivore use of rehabilitated sites varies among species and across seasons in the three neighbouring community ranches.

STUDY AREA AND SAMPLING STRATEGY

The study was conducted in Laikipia County located the northern-central Kenya (Fig. 1). The area falls in agro-ecological zone VI (semi-arid to arid land with rainfall less than 700 mm, suitable for ranching) (Jaetzold and Schmidt, 1983). One rehabilitated site was selected in Tiamamut, Kijabe and Nkiloriti group ranches within the Naibunga community wildlife conservancy. The relative frequency of wild and domestic herbivore distribution in relation to rehabilitated sites was estimated using dung counts. The dung of 5 wild mammalian herbivores including elephant (*Loxodonta africana*), zebra (*Equus burchelli*), Impala (*Aepyceros melampus*), grant's (*Gazella granti*) and Thomson's gazelles (*Gazella thomsoni*). The dungs of domestic stock, including cattle (*Bos indicus*), goats (*Capra aegagrus hircus*), sheep (*Ovis aries*) and donkeys (*Equus asinus asinus*), were also counted. Dung counts were done onsite (area within the perimeter of the rehabilitated site) and offsite (area beyond the rehabilitated site boundary) once every month for 12 months from January to December 2010. Onsite, dung was counted on the rehabilitated site along two randomly selected 200 m long and 10 m wide belt transects. Offsite dung was counted along two similar transects, radiating from each site, starting at the site boundary. All species left discrete dung piles. Along the transects, each pile of dung was attributed to species, with the help of local guides, guide books (Stuart and

Stuart, 1994) and personal experience. We tested for the effect of rehabilitated site, distance from the site and season on dung distribution using an analysis of variance (ANOVA) using the turkey significant difference (HSD) test in SPSS 16.0. On the distance scale, "0" represented the rehabilitated site itself. The effect of site, season and distance on dung distribution was analysed for all large herbivores collectively, then for individual species.

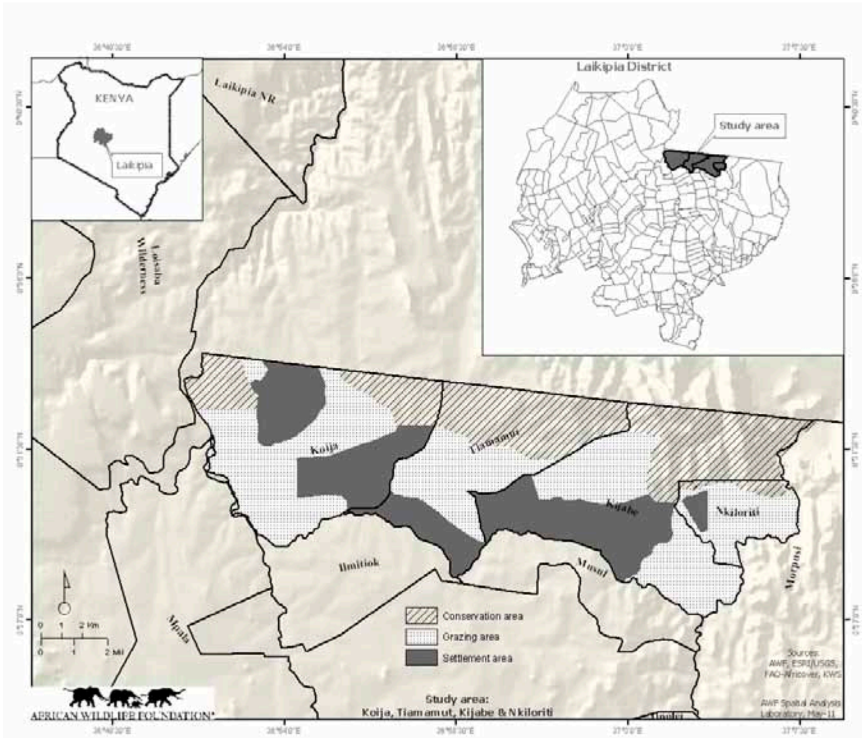

FIGURE 1: Study area showing Tiamamut, Kijabe and Nkiloriti Community Ranches in Laikipia and their land use zones

RESULTS

The general trend of wild herbivores dung densities in all the three sites showed a significantly higher aggregation of the mammals within the sites than the background areas (Table 1). The rehabilitated sites had significantly higher dung densities of wild herbivores than the background grazing areas. The dung densities of the wild herbivores visiting the sites followed a sine wave pattern, increasing during the dry season and decreasing during the wet season when the herbivores tended to distribute further throughout the range. The dung density of the domestic herbivores increased away from the sites. This perhaps was due to the deliberate herding restraining livestock from grazing in the rehabilitated sites. In all the three sites, dung densities of individual wild herbivore species studied were significantly influenced by distance (Table 2), decreasing sharply from onsite to offsite.

IMPLICATIONS FOR CONSERVATION MANAGEMENT AT THE WILDLIFE-LIVESTOCK INTERFACE AREAS

The creation of community wildlife conservancies is an opportunity for the local people to benefit from the wildlife existing in their land. Land use zoning within the framework of the Natural Resource Management plans in place at Naibung'a has created safe havens for wildlife in the community ranches core conservation areas. This notwithstanding, wildlife continues to roam freely in the grazing areas. The increased tolerance of wildlife in the community ranches by the pastoral communities (the land owners) is good for conservation, and it highlights the local people's changing attitude towards wildlife on their land. Certainly, more conservation milestones can be attained if pastoral communities can realize socioeconomic benefits from wildlife, and the negative wildlife-related impacts such as predation, disease and competition for forage and water minimised. Rehabilitation of degraded grazing areas through reseeding could be one way of addressing pasture scarcity cost and the attendant competition especially during the dry season for both wildlife and livestock.

TABLE 1: Onsite-Offsite effects on the individual species dung density in the rehabilitated sites

SOURCE		ONSITE - OFFSITE		
		TIAMAMUT	KIJABE	NKILORITI
SPECIES				
Elephant	F	42.727	26.322	108.061
	P	0.026	0.036	0.01
Zebra and Donkeys*	F	84.171	64.296	22.992
	P	0.012	0.015	0.041
Thompson's	F	51.778	158.065	105.217
	P	0.019	0.006	0.01
Grant's	F	100.189	32.564	62.847
	P	0.01	0.029	0.016
Impala	F	43.411	56.408	195.437
	P	0.022	0.017	0.005
Cattle	F	1.401	1.601	1.702
	P	0.358	0.333	0.322
Sheep and Goats*	F	1.897	2.608	2.03
	P	0.302	0.248	0.29
	df	1	1	1

*Zebra and donkey's dung was hard to differentiate, thus was lumped together. Similarly, sheep and goats' dung was also lumped together, as they are herded together

TABLE 2: Effects of distance on the individual species dung density offsite rehabilitated sites

SOURCE		DISTANCE		
		TIAMAMUT	KIJABE	NKILORITI
SPECIES				
Elephant	F	12.387	12.613	12.931
	P	0.013	0.012	0.011
Zebra and Donkeys*	F	11.471	11.579	13.566
	P	0.015	0.014	0.01
Thompson's	F	12.052	11.906	12.398
	P	0.013	0.014	0.013
Grant's	F	11.909	12.476	13.039
	P	0.014	0.012	0.011
Impala	F	11.817	12.708	11.361
	P	0.014	0.012	0.015
Cattle	F	8.379	8.609	10.151
	P	0.028	0.026	0.019
Sheep and Goats*	F	7.318	7.719	10.233
	P	0.035	0.032	0.019
	df	4	4	4

*Zebra and donkey's dung was hard to differentiate, thus was lumped together. Similarly, sheep and goats' dung was also lumped together, as they are herded together

CONCLUSION

The aggregation of wild herbivores around restored sites as shown in this study implies that range rehabilitation could be supplementary to the community conservation strategies at the livestock-wildlife interface areas in northern Kenya and elsewhere in Africa. Long-term research and monitoring of the impacts of rehabilitation in the grazing and settlement areas at Naibung'a conservancy on the dynamics of herbivores will continue to guide pragmatic management decisions on the ground. Best practices can then be replicated across the conservancies through a peer-learning strategy with an aim to conserve the rich diversity of wildlife in Ewaso Nyiro basin.

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28. A PRACTICAL AND ECONOMICAL METHOD TO PULSE AIR INTO SOIL IN VIRTUALLY UNLIMITED QUANTITIES: STRUCTURES DISCOVERED WHICH ENABLE AIR PERCOLATION INTO SOIL AND AT SPECIFIC DEPTHS

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Keywords: soil restoration, aerification, oxygen-transportation mechanism, fiber media structures, passive and active aerification

CONCEPT OF FIBER-MEDIA STRUCTURE FOR SOIL RESTORATION

Our work employs designed cylinder structures placed directly into the soil, and provides a powerful mode of soil restoration in as short a time frame as one week. These structures provide both a practical and an inexpensive method where air can be introduced into the soil in virtually unlimited quantities. This discovery is based on using an over-the-counter paper fiber product that is completely digested by micro-organisms in 3-5 months time. In that time period the fiber product, in the form of a cylinder placed vertical in the soil, will transport air, and therefore oxygen, directly into the surrounding soil. This oxygen introduction into the soil produces a huge increase in microbes that transform the soil porosity. Soil porosity transformation can be as short as 7-14 days for the case where the cylinder structure is filled with water once per day. Water-logged soils respond to aerification of the soil in 3-4 weeks.

DESCRIPTION OF STRUCTURE IN SOIL AND MECHANISM OF OXYGEN TRANSPORTATION

The cylinder structure is placed in the soil where the top of the cylinder is exposed at the soil surface. Good contact is achieved between the soil and the cylinder external surface simply by compacting the soil tightly around the cylinder in the soil. The mechanism of transport of air into the soil is due to differential surface tension inside the cylinder compared to the greater surface tension in the surrounding soil. The paper fiber material has void spaces between the fibers of the size where the air contained in the spaces in the fiber media is immediately compressed into small bubbles when water is adsorbed into the fiber network. In a second step, the water within the fiber cylinder is rapidly adsorbed into the surrounding soil due to the higher surface tension provided by the small spaces in the surrounding soil. This process of transporting air as tiny bubbles in water from the cylinder to the soil can be repeated as many times as necessary. In one set of experiments 207 repeated additions of water to a pencil-size fiber cylinder was demonstrated. We have coined the term 'breather tube' to describe how these simple structures can pulse essentially unlimited amounts of oxygen into soil.

FIBER PAPERS USED TO CONSTRUCT CYLINDERS

All kinds of high porosity paper fiber sheets from flax to abaca can be rolled into the shape of cylinders to form these breather tubes. The key is to have a highly porous paper that has excellent wet strength. The best and most economical paper product that we have identified is Bounty brand paper towels. This product has excellent wet strength and, in addition, is completely biodegradable. Cylinder structures of various sizes can be made by tightly wrapping the Bounty paper towel around a hollow-core pasta so that a completely biodegradable product is produced. Alternatively, the 5" diameter roll of paper towel can be used intact if the central hollow core is filled with, for example, pea-size gravel after placing the roll into a hole in the ground. The central core of the cylinder must be stable so that pressures within the soil will not collapse the cylinder shape of the structure. The soil must then be compacted tightly around any of the cylinders, regardless of size, so that good contact is achieved between the exterior surfaces of the cylinder. A good stable cylinder structure in the soil is essential to the air transport process.

DEEP SOIL COMPACTION RESTORATION APPROACH USING MODULAR CYLINDER STRUCTURE

We believe that there is a method where these cylinder structures can be used at any depth above the water table to reverse deep soil compaction. Our approach is to place a 5-6" paper towel roll into the soil where the cardboard center is stabilized by a tightly fitting, thin polycarbonate tube. This structure is placed into a hole drilled at the desired depth and at a diameter to match the size of the paper towel structure. Water is added to the exterior of the polycarbonate tube at the soil surface to fill the modular, 11" length of a standard size paper towel at the desired depth in the soil. The roll of paper towel is preferably glued to the polycarbonate tube prior to use deep in the soil. In this way, it will be possible to transport high levels of aerified water into the soil and in very high concentration.

TESTING OF FIBER MEDIA STRUCTURES

We have completed testing of these structures in public properties in the Borough of South Plainfield in July of 2011. These tests achieved the objective of soil porosity improvement as gauged by high density of worms re-populating the clay soil in this area. These positive test results are analogous to tests in 25 residential properties in South Plainfield and in Scotch Plains, NJ completed in 2010-2011. We have tests underway also in two water retention basins in Edison, N.J. owned by New Jersey Department of Transportation. The objective of these tests is to evaluate if the breather tubes can improve water percolation rates by improving soil porosity in both basins.

These paper cylinders have been demonstrated to be highly effective in elimination of water-logging of soils in areas in flood plains and in water-logged areas covered by grass in residential areas, even in high clay soils. In analogy, these cylinders also eliminate static, mosquito-breeding ponds in flood plains composed of muck in the relatively short time frame of three weeks. In addition, the pungent odor associated with the decaying plant matter in several flood plains disappears when the paper cylinders were placed into the central flow channel of the flood plain.

29. CONTRIBUTION OF ECOSYSTEM RESTORATION TO SOIL SERVICES AND BIODIVERSITY

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Keywords: soil ecosystem services, soil microorganisms, diversity, sustainable use of biodiversity, restoration

INTRODUCTION

The Convention on Biological Diversity established three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (CBD 2000). Biodiversity (including wide variety of plants, animals and microorganisms) was not entirely identified and estimates range from 3 to 100 million species. Biodiversity also contains genetic differences within species and provides a large number of goods and services for humans. Biodiversity in all biomes is sensitive to global changes in environment and land use (Figure 1); however, in tropical ecosystems which are under high mismanagement and declining soil fertility (that have allowed to river pollution) services of soils must be more discussed. Arbuscular mycorrhizal fungi (AMF) constitute an important component of the soil microbial community and are extremely successful microfungi that form mutualistic symbioses with 80% of all plant species. AMF participate in ecosystem services such as increasing soil structure, protecting soil carbon (C) against mineralization, and protecting tree roots against disease or drought (Simard and Austin 2010). Moreover, it is known that mycorrhizas and black C (biochar) are theoretically essential in various soil ecosystem services, contributing to sustainable plant production, ecosystem restoration, and soil C sequestration and hence mitigation of global climate change (Warnock et al. 2007). The ecosystem services of soils are often not recognized and the impact of agriculture on soil structure (essential for facilitating water infiltration, success of sustainable agriculture, and preventing erosion and flooding) or changing soil species inhabitants is an issue urgent to study.

PHOTO: M Pagano 2011

FIGURE 1: Global change registered in lands from Brazil.

CONSERVATION IN THE CONTEXT OF RESTORATION

Restoration can have significant implications for biodiversity conservation: it is known that restored forests can improve ecosystem services and enhance biodiversity conservation; however, will not arrive at the same composition and structure of the original forest cover. Thus, tactics to restoring forest ecosystems depend on levels of soil degradation and desired restoration results (Chazdon 2008).

Motivated efforts to restore forests, ecosystem services, and biodiversity throughout the world which combine with sustainable rural incomes and community participation will require adaptive management as dynamic, resilient systems that can resist anthropogenic stresses e.g. climate change and habitat fragmentation (Chazdon 2008). Approaches on recovery of ecosystem services by drawing on soil services, soil biodiversity and on current thinking on ecosystem restoration to attain a better understanding of ecosystems need connectivity areas such as corridors assisting species to respond and survive the biome shifts caused by global change. However, it will involve regional understanding and cooperation between researchers, policy makers and the community.

Ecosystem services depends on soil properties, soil conditions (e.g. moisture, temperature) and on the biological processes (species interactions e.g. symbiosis, competition) as well as on the ecosystem management (e.g. tillage), which select organisms present (Dominati et al., 2010; Pagano, 2011). Soil fungi such as arbuscular mycorrhizal fungi (AMF) (present in all terrestrial biomes, generally found in soils with low water availability, low nutrients or polluted, but also in aquatic environments) form symbioses with most plants enhancing the uptake of nutrients and protecting plants from stresses, e.g. drought. Thus, the ecosystem services from soils, e.g. the biological control of pests and diseases (Dominati et al., 2010) and nutrient cycling from soil (Quijas et al., 2010) are supported by symbiotic plants (*rhizobium* and/or mycorrhizae), which promotes benefices.

As mycorrhizal fungi respond to disturbances, while other organisms do not (Baar, 2010), and are the most common symbioses in plants, we must utilize mycorrhizal interactions for restoration of disturbed ecosystems, the reclamation of sites contaminated by industrial pollution and mine wastes, increasing fertilizer use efficiencies (with all associated economic and environmental benefits) (Warnock et al. 2007). As discussed in the examples of ecological restoration below.

In Brazil, Pagano et al. (2007, 2008, 2009) have showed that all plant species (most leguminous trees recommended for land restoration) presented AM colonization and a significant AMF diversity in preserved sites (Table 1). They obtained the mycorrhizal status for 33 terrestrial plants and ferns investigated both in riparian and dry forests (Pagano 2011, Pagano and Araújo 2011). Overall, it appears that the priority sites for conservation correspond to undisturbed forests, as well as reforested sites such as agroforestry systems and riparian farm forest (degraded by cattle). Several studies showed that AMF abundance, biomass and diversity are more important drivers of management-induced changes in aggregate stability and soil nutrients; moreover, increased soil macroporosity (Table 1) in relation to more disturbed sites speaks in favor of an increasing soil quality because macropores enable rapid drainage through the soil profile promoting a better tree growth.

TABLE 1: Hypothesized soil services, soil fertility and AMF diversity in ecosystems from Brazil

ECOSYSTEM	SOIL SERVICES	M	SOIL FERTILITY	AMC	AMF MORPHOLOGICAL DIVERSITY	AMF GENETIC DIVERSITY
DF (undisturbed)	Water provision to plants	24.7	low	+	4 genus/ 6 spp	24 spp
DF (reforested) ‡	Water provision to plants	~29	>	high	4 genus/ 9 spp	11 to 20 spp
RF (undisturbed)	Flood mitigation	30.2	medium	high	5 genus/ 8 spp	NE
Urban‡ RF	Flood mitigation	10.6	>	medium	6 genus/ 7 to 9 spp	NE

DF = dry forest; RF = Riparian forest; M = Soil macroporosity; AMC = Arbuscular mycorrhizal colonization (%); ‡Mean of data from riparian zones of Sabará and Velhas Rivers. + = Presence; > = higher due to use of fertilizer, NE = non evaluated. References: Pagano et al. 2008, 2009; Pagano 2011.

CONCLUSION

It is concluded that undisturbed systems with diversified native trees promoted the soil environmental services, but restored sites also presented similar values and can be considered essential for ecosystem services. Finally, planted and natural forests, and agroforestry systems are the best options to manage aboveground and belowground environmental services while inoculation should be used to increase the abundance of soil organisms. Among identified areas of greatest importance for conservation are undisturbed sites, headwaters and riparian zones of upstream rivers.

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30. RESEARCH PROGRAMME, SUSTAINABLE LAND MANAGEMENT AND ITS CONTRIBUTION TO ECOSYSTEM RESTORATION

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Keywords: Sustainability, Land management, Ecosystem Services, Restoration

INTRODUCTION

In the Strategic Plan of the CBD for 2011-2020 Parties agreed on several targets that directly mention restoration and sustainable use, inter alia:

- Target 14: restore by 2020 ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being,
- Target 15: restore at least 15% of degraded ecosystems by 2020,
- Target 7: by 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

This demonstrates that the CBD values restoration of degraded ecosystems as an important instrument of land management to reverse the negative impacts unsustainable use has on biodiversity and to enable sustainable use of restored ecosystems.

RESEARCH PROGRAMME 'SUSTAINABLE LAND MANAGEMENT'

The international research programme 'Sustainable Land Management' is funded by the Federal Ministry for Education and Research of Germany for a projected duration of five years (2011-2015).

At the hand of various examples, the research projects funded by the programme develop new models, technologies, system solutions and policy strategies for sustainable land management, including restoration. The projects take into account integrative, interdisciplinary and regional perspectives, which enables them to address the variety and complexity of the demands placed on land and natural resources. Research is oriented towards policy development and the project scientists of the joint research teams from Germany and the host countries work in close cooperation with regional and international stakeholders.

Some examples of restoration related research include:

Comtess (Sustainable Coastal Land Management: Trade-Offs In Ecosystem Services)

The Comtess project develops scenarios for coastal management in Germany to adapt to climate change e.g. to create a second line of dikes behind the outer one instead of heightening the existing dike. This would lead to a retention area between the two dike lines which could hold back salt water during high floods as well as fresh water during rainy periods. This fresh water could hinder salt water intrusion into the soils which could be used for planting e.g. reed beds for energy production. These reed beds would at the same time serve as habitat for adapted species, e.g. breeding and roosting birds.

Further information: http://modul-a.nachhaltiges-landmanagement.de/en/collaborative-projects/comtess/

SuMARiO (Sustainable MAnagement of River Oases along the Tarim River/China)

The overarching goal of SuMaRiO is to support oasis management along the Tarim River in the Northwest of China under conditions of climatic and societal changes. The contribution to the aspect of restoration is the research on suitable irrigation methods for soils under the pressure of salinity and to investigate the possibilities of replanting saline soils with endemic crop plants.

Further information: http://modul-a.nachhaltiges-landmanagement.de/en/collaborative-projects/sumario/

Carbiocial (Carbon Sequestration, Biodiversity and Social Structures In Southern Amazonia)

Land use intensification is associated with (a) losses of ecosystem services like the loss of natural vegetation and associated ecosystem functions in the global and regional climate system, and (b) increasing releases of greenhouse gases (GHG), and (c) the reduction of livelihoods. For the project three regions along the land use frontier of Southern Amazonia were selected: Southern Pará: most active deforestation; Northern Mato Grosso: young soy bean production; Central Mato Grosso: established cultivation (>20 years) and adapted mechanised cropping (e.g. no till). Analyses focus on soil carbon (C) turnover, climate, ecosystem functions and socio-economic processes. The research in restoration is focused on soil restoration, by e.g. black carbon enrichment (biochar).

Further information: http://modul-a.nachhaltiges-landmanagement.de/en/collaborative-projects/carbiocial/

SASCHA—Sustainable land management and adaptation strategies to climate change for the Western Siberian corn-belt

The interface between the steppe and the northern forest zone in Western Siberia is of global significance in terms of carbon sequestration, food production, and biodiversity. All these subject matters have been and will continue to be affected by climate change and rapid socio-economic development. SASCHA investigates interactional effects of climate and land-use change on natural resources and ecosystem functions within the Pre-Taiga and Forest-Steppe ecotone. Subsequently, sustainable land-use practices, restoration concepts and adaption strategies to climate change will be developed. The second project phase is dedicated to the introduction of implementation and monitoring tools for the restoration and protection of essential ecosystem function through a wise future land use in the region. All research, development and implementation activities will be carried out in close cooperation with regional and local stakeholders from science, administration, and practice. The project results are transferable to neighboring regions facing similar land-use problems.

All regional projects (figure 1) in the international Module A of the 'Sustainable Land Management' programme are coordinated by the Scientific Coordination GLUES (Global Assessment of Land Use Dynamics, Greenhouse Gas Emissions and Ecosystem Services – Scientific Coordination and Synthesis) which performs a distinct work package for linking project results to Multilateral Environmental Agreements including the CBD.

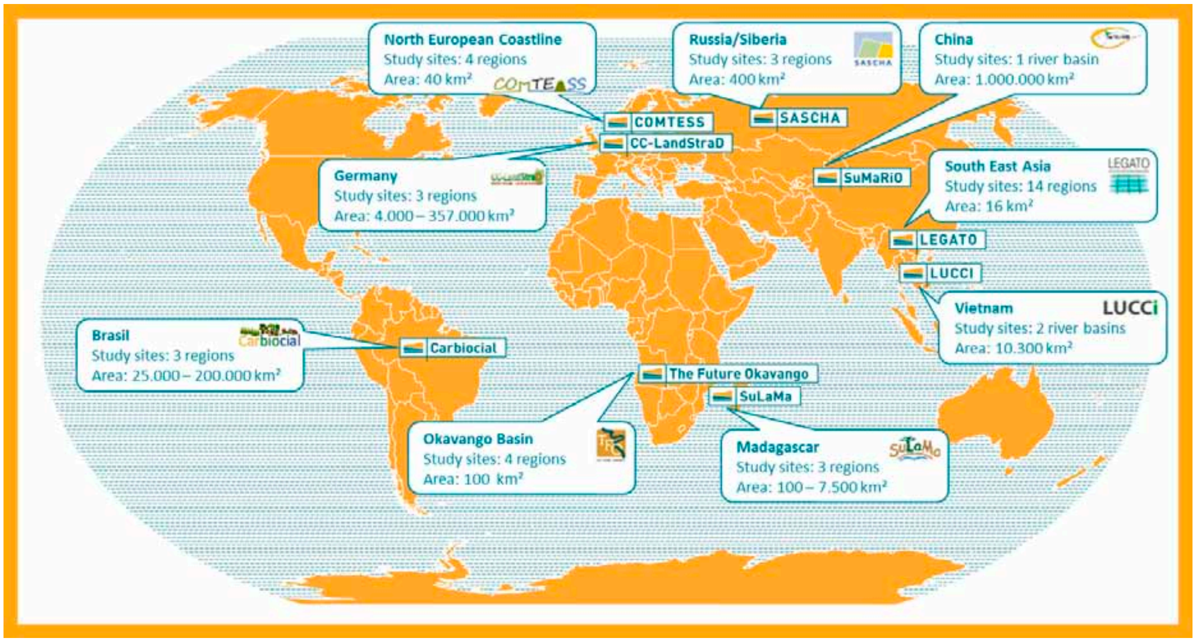

FIGURE 1: The map shows the distribution of the Regional Projects of Module A of the research programme 'Sustainable Land Management'.

31. FROM SEMI-NATURAL HABITATS TO HEAVILY DAMAGED LANDSCAPE AND BACK: ECOSYSTEM RESTORATION IN THE BLACK TRIANGLE, NORTHERN BOHEMIA, CZECH REPUBLIC

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Keywords: Czech Republic, Northern Bohemia, Black Triangle, air pollution, brown coal mining, ecosystem restoration, ecosystem approach, holistic view, wildlife communities/assemblages/guilds, participatory approach

INTRODUCTION

Ecosystem restoration, the process of actively managing the recovery of an ecosystem that has been degraded, damaged or destroyed, is a conscious intervention based on traditional or local knowledge, scientific understanding, and the recognition that what previously existed was precious and indeed necessary for the continued health and survival of many species, including humans. The process aims at restoration of ecosystems to be resilient and self-sustaining with respect to their structure (species composition, physiognomy) and functional properties (e.g., ecosystem functioning) as well as being integrated into the wider landscapes and supporting sustainable livelihoods (Van Andel & Aronson, 2006; Nellemann & Corcoran, 2010).

THE BLACK TRIANGLE

The "Black Triangle," where Poland, Germany and the Czech Republic meet together, is one of Europe's most heavily industrialized regions. As the name implies, it is also one of the most heavily polluted areas in the world— plagued for decades by choking coal dust emitted by electric power and district heating plants. The pollution source is primarily lignite, a soft brown coal mined locally. Inexpensive and readily available, its widespread use represents one of the short-sighted energy policies of the area's former communist governments. Since the Cold War ended, efforts have been made to reverse the Black Triangle's air pollution legacy, with promising results already in evidence.

ECOSYSTEM RESTORATION IN PRACTICE

A multidisciplinary team from the State Nature Conservancy, universities, NGOs and private companies has been dealing with ecosystem restoration in the Black Triangle since the early 1990s, after the political changes in the former Czechoslovakia.

Integrated ecosystem assessment was carried out in some areas in the Czech part of the Black Triangle (Northern Bohemia) using a range of various methods (e.g., biodiversity assessment at the species/communities level, monitoring of ecosystem processes, e.g., ecological succession, land degradation incl. soil salinity, water retention, primary production quantification, GIS techniques, remote sensing methods, etc.). During the research, ecological/functional group dynamics was also studied in relation to main ecosystem processes. Special attention has been paid to invasive alien species during various stages of ecological succession. In addition, ecosystem modelling and scenario analysis was also applied in proposal how to restore heavily degraded ecosystems. Among others, old maps and other documentation (pictures, description of landscape scenery, etc.) were also used. Key environmental variables in air and water pollution have been monitored using the standard methodology in the field.

The project's task is not only to propose ways and means how to restore severely damaged ecosystems, but mainly how to maintain resistance/resilience of the restored ecosystems also in the future when the synergistic effect of various drivers, particularly climate change and habitat fragmentation, degradation and loss, shall influence the restored landscape.

From the very beginning, the key stakeholders have been involved into the project implementation following the participatory approach and the CBD´s ecosystem approach principles (Pecharova & Martis, 2008; Pecharova et al., 2011).

The outputs of the project were submitted to the relevant public bodies and companies and are available for the general public as well as for the target groups.

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32. ADDRESSING THE TAXONOMIC COMPONENT IN ECOSYSTEM RESTORATION PROGRAMS

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Keywords: Taxonomic component, Ecosystem Restoration Programs, Biodiversity, Species inventory

INTRODUCTION

The Millennium Ecosystem Assessment-2005 has identified human activity as a significant and escalating factor negatively impacting the biodiversity of ecosystems. Ecosystem well-being, human welfare and economic development are measures that reflect a direct linkage. A global decline in biodiversity has also led to a decline in the services delivered by the ecosystems. The headline targets 14 and 15 of the Strategic Plan for Biodiversity 2011-2020, deal with ecosystem restorations, the target 15 in particular aims for the restoration of at least 15% of the degraded ecosystems by 2020 (COP 10, 2010).

Ecological or ecosystem restoration as defined by the Society for Ecological Restoration International Science & Policy Working Group, 2004 (SER) is the process of assisting the recovery of an ecosystem that has been degraded damaged or destroyed. The process involves re-establishing the historical trajectory of an impaired ecosystem with respect to its structure and function, based on which, the key ecosystem variables/components- the flora and fauna along with their niches and functions are identified and revived or reintroduced. Viable biotic communities are thus rebuilt in accordance with the current environmental conditions. The success of an ecorestoration venture largely depends on the degree of knowledge among the participants, on various aspects like habitat structure of the specific ecosystem, the taxonomy, geographical distribution and affinities of the floral and faunal elements and also the ecosystem dynamics at various trophic levels. It is intended to explore here, the levels of taxonomic services involved and also the kind of taxonomic support needed for an effective implementation of the ecological restoration programs. The taxonomic components are best understood, once the restoration concept is viewed in the context of Biodiversity protection /conservation. As per the Convention on Biological Diversity (CBD), the taxonomic knowledge is a key input in the management of ecosystems (Global Taxonomy Initiative, 2011).

LEVELS OF TAXONOMY IN ECORESTORATION PROGRAMS

Once the foremost step of setting up a habitat with similar geophysical and ecological parameters of a non-degraded site (a reference system) is achieved, the next step in the ecorestoration process is promoting the colonization of the dominant and indigenous floral-faunal assemblages. In the Western Ghat Rainforest Restoration Project in India (Mudappa and Raman, 2010), about 160 native tree and liana species were raised. Thus the Level-1 service of the science of taxonomy in ecorestoration projects is to ensure an accurate species level identification of the dominant and indigenous biota of a specific ecosystem, through inventorying. Only when the correct species' name of an organism is made available, can the known bioecological and other related information with regard to the species be retrieved. The characteristic assemblage of the species is what which ultimately define the community structure of an ecosystem. In specialized ecosystems like mangroves, the presence and absence of a few dominant species can be inordinately crucial in shaping the community structure. In certain cases as of the rainforests, the species composition at different layers, like the forest floor, the canopy, the under storey etc. have to be evaluated separately. Thus, analysis of the species composition of the ecological communities can be considered as the Level- 2 service provided by Taxonomy. The Level- 3 service is sought to distinguish between the native species, the exotic species and also the invasive aliens in the reference ecosystem and also in the post project monitoring phases of the restored ecosystem. This step is vital in the current scenario where Invasive Alien Species are categorized as the second greatest threat to biodiversity after habitat change.

TAXONOMIC PRODUCTS

The aforementioned levels of taxonomy and the taxonomic products and deliverables discussed here have been focussed on the basis of an understanding on the actual needs of ecorestoration programs and also in consultation with the *'SER International Primer on Ecological Restoration'*. The taxonomic products need be designed in ways in which they can be used by the non-taxonomists too with ease. Ecosystem specific Interactive identification systems (IIS) have to be generated using the current taxonimc softwares like LUCID PHOENIX, FACT SHEET FUSION, DELTA/INTKEYS. The IIS can very well accommodate the interactive keys and species' home pages, with all the basic information, including diagnosis, synonyms, common names and also high quality images and distribution maps of the species. DNA barcodes of species can also be appended. Eventually an ecosystem specific central database, with current valid names of the species encountered, has to be developed. The database has to be in tune with the species list in the baseline inventory of the reference ecosystem(s) or the one undergoing the process of restoration. The central database should have links provided to the taxonomic keys and also to the species' home pages.

TAXONOMIC CAPACITY

The required taxonomic capacity to ensure precise identification of the flora and fauna and prompt delivery of the ecosystem specific taxonomic products can be achieved by mobilizing a central Taxonomic Working Group (TWG) at local/regional/national/international level. TWG, a multi institutional collaborative venture, once established can cater the general taxonomic requirements at national and international level as well. The related reference collections and voucher specimens can be maintained by recognized regional/state/national or international repositories, which can ensure public access to the materials for future studies.

Addressing the taxonomic component in ecorestoration programs as enumerated above, will enhance the overall taxonomic capacity of the nation, eventually leading to a better understanding and conservation of life forms.

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33. A STRATEGY FOR ECOLOGICAL RESTORATION AT A WILD AREA INSIDE A SEMIDESERTIC BOTANICAL GARDEN IN CADEREYTA, MEXICO.

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Keywords: succession, operational plan, carrying capacity, reservoir, plant assembly.

A WILD AREA INSIDE A BOTANICAL GARDEN

The Regional Botanical Garden of Cadereyta (JBRC, on its Spanish acronym) is a research center dedicated to the study, conservation and management of Mexican arid flora. It is located in the city of Cadereyta, in the state of Queretaro, central Mexico. It occupies a surface of 15.33 hectares, 13.5 of which are a wild area (Figure 1). Almost half of this space (7.3 ha) is a place of disturbed and transitional vegetation where species like mezquite (*Prosopis laevigata*), nopal (*Opuntia* sp.), maguey (*Agave mapisaga*), sangregado (*Jatropha dioica*), biznaga de chilitos (*Mammillaria uncinata*), as well as several grasses can be found (Table 1); and the rest (6.2 ha) is represented by a crop of yucca palms (*Yucca filifera* and *Yucca valida*). JBRC started in 1990, when an agreement was signed by the council of Cadereyta, the community of Fuentes y Pueblo Nuevo and the Council of Science and Technology of the State of Queretaro (CONCYTEQ), to create a space for flora conservation.

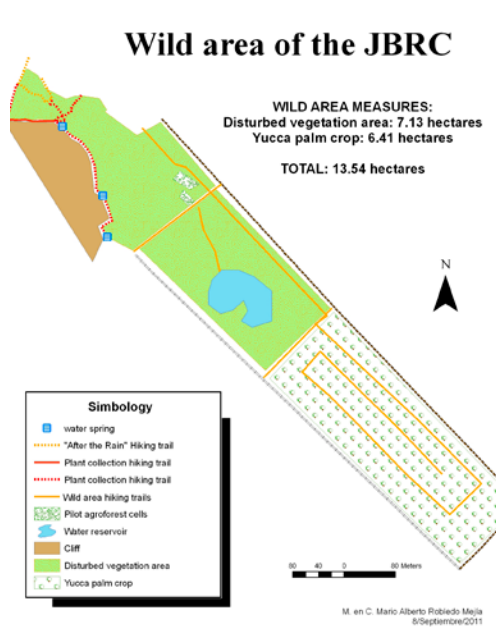

FIGURE 1: Map of the wild area

In 2003, an initial development plan for this place was designed; later (Sanchez and Sanaphre, 2009) CONCYTEQ published the "Integral management plan for the Botanical Garden of Cadereyta"; which marks off the place into three different zones according to their use, physical and biological conditions and activities that can be developed there: a) plant collections and greenhouse facilities; b) water reservoir and hiking trails; and c) yucca palm crop. The wild area considered for restoration management is constituted by the water reservoir, hiking trails (both located in a disturbed vegetation area) and the yucca palm crop.

CHALLENGES FOR RESTORATION

The main challenge is the elaboration of a restoration plan with a correct design, respecting the successional stages of native vegetation. The area has a half hectare water reservoir, built in 2005, non functional due to the high permeability of the soil, which restricts its water retention. A water body would provide humidity to the area, allowing a successful establishment of native plants which would constitute a natural habitat for wild animals and other organisms. The use of designed hiking trails would help to avoid disturbance, and a security plan in this lonely place is also necessary. An additional challenge is the removal of some invasive grasses such as *Melinis repens* and *Eragrostis mexicana*. These and other invasive plants compete directly with native plants and exclude them, avoiding diversification and establishment of native species.

TABLE 1: Some species of the wild area at the Regional Botanical Garden of Cadereyta

BOTANICAL FAMILY	SPECIES	BOTANICAL FAMILY	SPECIES
Agavaceae	*Agave mapisaga*	Convolvulaceae	*Evolvulus alsinioides*
Agavaceae	*Yucca filifera*	Convolvulaceae	*Dichondra argentea*
Agavaceae	*Agave salmiana*	Crassulaceae	*Villadia parviflora*
Amaranthaceae	*Iresine schaffneri*	Euphorbiaceae	*Jatropha dioica*
Amaranthaceae	*Gomphrena decumbens*	Fabaceae	*Dalea citriodora*
Asteraceae	*Coreopsis mutica*	Fabaceae	*Dalea bicolor*
Asteraceae	*Tagetes micrantha*	Fabaceae	*Calliandra eriophylla*
Burseraceae	*Bursera fagaroides*	Krameriaceae	*Krameria cytisoides*
Cactaceae	*Ferocactus latispinus*	Malvaceae	*Sida aff. procumbens*
Cactaceae	*Cylindropuntia imbricata*	Oxalidaceae	*Oxalis decaphylla*
Cactaceae	*Mammillaria uncinata*	Poaceae	*Bouteloua gracilis*
Cactaceae	*Opuntia cantabrigiensis*	Poaceae	*Melinis repens*
Cactaceae	*Coryphantha radians*	Poaceae	*Eragrostis mexicana*
Cactaceae	*Stenocactus pentacanthus*	Portulacaceae	*Talinum napiforme*
Cactaceae	*Opuntia imbricata*	Rhamnaceae	*Karwinskia humboldtiana*
Cactaceae	*Opuntia hyptiacantha*	Rubiaceae	*Bouvardia terniflora*
Cactaceae	*Ferocactus histrix*	Turneraceae	*Turnera difusa*
Caryophyllaceae	*Cordia congestiflora*	Ulmaceae	*Celtis pallida*

RESTORATION OUTLINE

Design of an operational plan

At the JBRC, we are working in the design of a plan that will be used as a strategy to coordinate the restoration efforts for the wild area. It includes different actions and methods by zone:

Hiking trails and water reservoir

The area already has some trails used by tourists, and some others under construction. Carrying Capacity calculation (Cifuentes, 1992) is used as a strategy to avoid perturbation, through the estimation of the number of tourists that the wild area can handle per day. Those data allow the responsible use of a wild area for touristic purposes. The empty water reservoir will be diagnosed to determine the cause of its malfunction; once the cause is determined, a strategy will be implemented to solve the water retention problem.

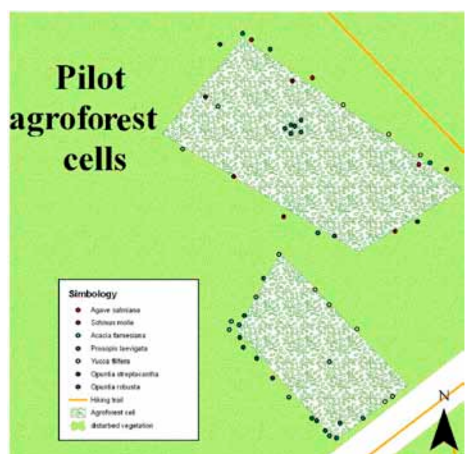

FIGURE 2: Tentative locations for the agroforest cells and existing plants.

Disturbed vegetation area

The area surrounding the reservoir will be managed using plant assemblies for wild patches of vegetation (Hernandez, 2007). This will be part of an environmental education plan, where children will plant species of the four successional stages (colonization, nucleation, establishment and closed canopy), constructing patches of xerofile and deciduous vegetation. Another portion of the zone will be used to make "agroforest cells" (Figure 2), based in the backyard model developed by

Terrones *et al.* (2006), where native and commercial plants are mixed in order to develop crops used to get natural resources. In the agroforest cells, the crops will be abandoned after a few years of productivity but native plants will remain, creating a native vegetation core.

Yucca palm crop
The Botanical Garden works in partnership with other institutions, like the Autonomous University of Queretaro (UAQ). This college is developing a bird inventory in the wild area, information that will be used for bird watching activities. Several birds use the yucca palm crop as their habitat, turning this into a good place for tourism.

IMMEDIATE ACTIONS

New hiking trails will be implemented and the carrying capacity will be estimated to protect the wild area. Plant plots for reintroduction have been cultivated in the greenhouses, and they will be used in agroforest cells and patches of vegetal assemblies. Harmful invasive grasses will be selected and removed prior the native plants reintroduction.

EXPECTATIONS

All the actions of the operational plan are thought to restore the place by controlling disturbance factors that interrupt succession, maintaining active successional stages (Jardel, 2008), enriching and conserving a perturbed wild area. JBRC expects a long-term recovery of the natural conditions of this area. We do believe that the restoration actions that we are starting on these days will thrive our nature management capacities towards the achievement of the new 2011-2020 Global Strategy for Plant Conservation targets.

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34. DO THE IMMEDIATE EFFECTS OF FOREST RESTORATION TREATMENTS DISRUPT THE POPULATION EXPANSION OF BRYOPHYTES GROWING ON DEAD WOOD? – A SPORE DEPOSITION STUDY

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Keywords: bryophyte, colonization, dispersal, fire, boreal forests

INTRODUCTION

The sustainable use of boreal forests must include an awareness of dispersal and colonization potentials and abilities of different species groups. These are especially important for the epixylic (growing on dead wood) bryophytes occupying temporal, patchy habitats, such as logs, in the current fragmented forest landscape. Bryophytes are an ecologically important plant group in boreal forests (e.g. Frisvoll 1997). Reproduction by spores or gemmae, dispersal and successful spore/gemma establishment are all crucial steps in the bryophyte life cycle. It is not well known what effects restoration treatments (prescribed burning and loggings) have on the amount and quality of bryophyte spore deposition on logs, i.e. how severely these treatments disrupt the population expansion of bryophytes growing on dead wood. This is in the scope of our investigation. Our aims are to find out 1) what are the quality and quantity of the spore deposition on the logs after the restoration treatments and 2) the temporal variation in the spore deposition.

MATERIAL AND METHODS

The experimental forests are located in Evo area, Lammi, Southern Finland. The Norway spruce (*Picea abies*) forest stands were restoration felled in the winter 2001-2002, and burnt in the summer 2002. The experimental setup included two forest restoration treatments (burning, down retention logging + burning), and control forest stand. This study is based on the field experiment, where micro slides coated with Vaseline were used as spore traps (Figure 1). The quality and quantity of the spore deposition on the slides were studied in an area of 2-3 cm², and bryophyte spore types were separated from fungal spores based on spore morphology, size, colour etc. (see Boros et al. 1993).

FIGURE 1. Experimental setup for the spore trapping study. This forest stand was restoration felled (down retention trees 30m³) and burnt prior to the spore trappings.

RESULTS AND DISCUSSION

The immediate effects of fire were very severe, reducing the bryophyte coverage on the logs from on average 20% (before the fire) to almost 0% (after the fire). However, bryophyte colonization on the burnt logs started very fast, and first newly established shoots of *Ceratodon purpureus* were observed 2 years after the fire (Ryömä & Laaka-Lindberg 2005). Our spore deposition data also supports the evidence of rapid bryophyte (re)colonization on the logs. We observed substantial amounts of spores on our traps, greatest part being fungal spores (Figure 2). According to our preliminary data, there seems to be unexpectedly minor variation in bryophyte spore deposition both temporally and between the restoration treatments (Figure 3).

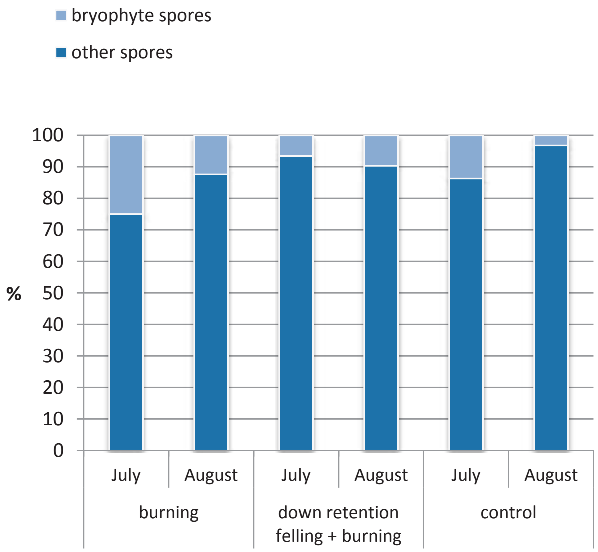

FIGURE 2. Bryophyte spore amounts in proportion to other, mainly fungal, spores.

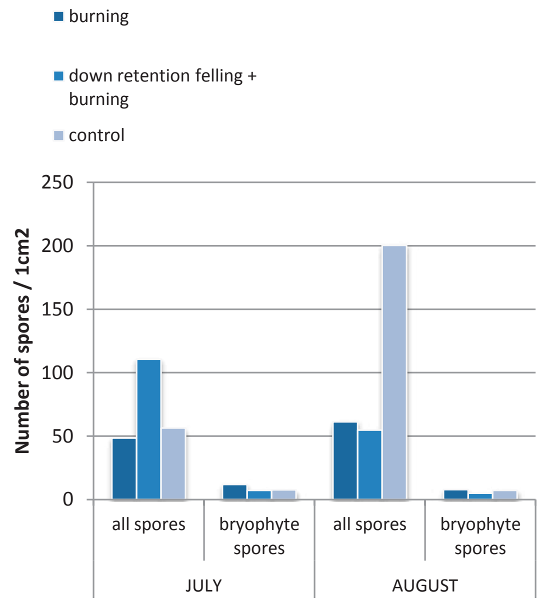

FIGURE 3. Preliminary spore counting data shows the great variation in the average amounts of all spores/1cm^2, whereas the amounts of bryophyte spore types seem to be fairly constant.

Even though the spore and gemma dispersal distances in bryophytes have been shown to be fairly short (e.g. Söderström & Jonsson 1989, Pohjamo et al. 2006) and the great part of bryophyte spores is known to fall within a few meters of the parental gametophyte (e.g. Söderström & Jonsson 1989), the existence of long-distance dispersal and landscape-level spore deposit seems clear, since we observed bryophyte spore deposition on our traps immediately after the fire, in the situation where almost all the spore-producing bryophyte colonies in the close vicinity of our logs were destroyed or severely damaged. This finding supports the evidence that long-distance dispersal may contribute to the bryophyte (re)colonization more than previously thought (see also Pohjamo et al. 2006, Hylander 2009, Hylander & Johnson 2010, Sundberg 2010). The next step in bryophyte life cycle after spore/gemma deposition on burnt wood is successful germination. The effects of the substrate quality (pH, temperature, degree of charring) on this, and thus the long-term effects of fire on epixylic bryophyte community dynamics, still require further studies.

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35. USE OF GEO-SPATIAL TOOLS IN THE MANAGEMENT OF POTENTIAL HABITATS OUTSIDE THE PROTECTED AREAS IN THE TRANSBOUNDARY BRAHMAPUTRA-SALWEEN LANDSCAPE

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Keywords: conservation landscape, habitat restoration, protected areas, habitat corridors, habitat suitability modelling

INTRODUCTION

The Brahamaputra-Salween Landscape (BSL) is an exceptionally biodiversity rich area of the eastern Himalayas shared by China, India, and Myanmar. Formal boundary delineation for the landscape will take place through further consultation among the three countries; the provisional extent of the BSL is shown in Figure 1 and includes a number of adjoining protected areas (PAs) in the three countries and some adjoining areas outside. The landscape includes several well-known protected areas such as the Namdapha National Park (NNP) and Tiger Reserve in Arunachal Pradesh (India), Hkakaborazi National Park (HNP) in Kachin State (Myanmar), and Gaoligongshan National Nature Reserve (GNNR) in Yunnan Province, China. These protected areas have a common ecosystem shared by many species of global importance, such as tiger, clouded leopard, snow leopard, common leopard, hollock gibbon, and Namdapha flying squirrel, as well as many endemic flowering plant species. These protected areas have not only conserved the rich biodiversity of the landscape but have also supported the livelihoods and cultural dependencies of the diverse ethnic communities living in and around them. Given the several conservation and development challenges, including climate change vulnerability, it is crucial to have an effective protected area system with long-term monitoring of biodiversity and socioeconomic systems to sustain the ecosystem services and enhance the livelihood opportunities for local people. Several studies have stressed the need for complementing the PAs with supportive mechanisms for restoration of rapidly degrading habitats outside the Pas, and for providing communities with conservation-linked alternative economic incentives (Stotz et al. 2003; Aung 2007; Chatterjee et al. 2006). Already, there are several habitats with unique ecological situations outside the PAs identified as priority conservation sites. In order to strengthen the argument for restoration of habitats outside the PAs, a geo-spatial analysis based on a habitat suitability model was used in the BSL as part of the broader pre-feasibility studies conducted by the three countries in the landscape.

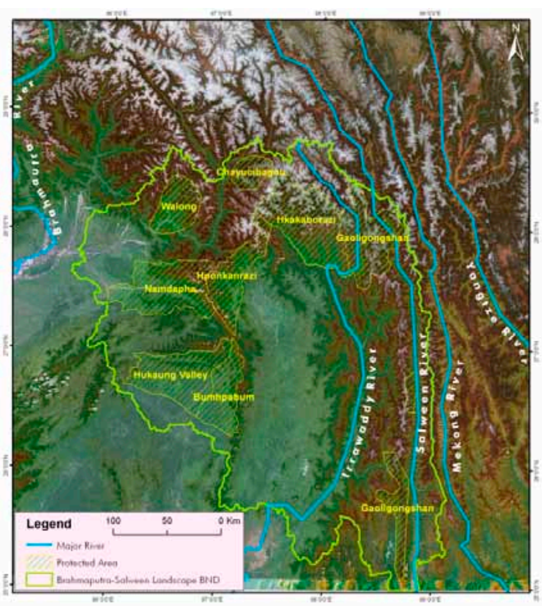

FIGURE 1: Tentative extent of Brahmaputra-Salween Landscape based on the watershed boundary covering the protected areas (source of protected area boundaries: World Database on Protected Areas)

HABITAT SUITABILITY MODEL

ICIMOD carried out a preliminary corridor identification analysis for the BSL based on habitat suitability models for two species: leaf deer and takin. The Corridor Designer toolbox(http://corridordesign.org/designing_corridors/habitat_modeling/) was used in an ArcGIS 9.3 platform to design wildlife linkages/corridors to determine the best available habitat for individual wildlife species between the protected areas. Several parameters such as habitat patches, movement resistance, and suitability with relation to the raster-based thematic layers such as land use/land cover, elevation, topographic position, and human disturbance (e.g., distance from roads, trails, and settlements) were used for corridor design. Land cover is often the most important factor in habitat models for many species because it relates to food habitat, hiding cover, thermal cover, and human disturbance. The information on land cover was derived using the eCognition Developer with Object-Based Image Analysis (OBIA) technique. Additional thematic layers were collected from secondary sources and reclassified as input to the habitat suitability model. According to the relative importance of the thematic layers, certain weights were assigned to combine multiple habitat factors into one aggregate habitat suitability model. Weighting parameters were determined using species distribution information from the relevant literature. Once all the layers were weighted, the corridor design tool was used to generate the habitat suitability for the species. Next, the potential habitat patches were identified by specifying the threshold habitat quality for breeding and the minimum suitable area necessary to sustain a breeding pair or population.. Finally, a tentative area for a corridor between the protected areas was delineated using a corridor model input of habitat suitability and habitat patches, which was further evaluated by considering the corridor profile.

IDENTIFYING POTENTIAL HABITATS OUTSIDE THE PAS

The geo-spatial assessment showed that the two species have a contiguous habitat across the two protected areas NNP of India and HNP of Myanmar (Figure 2) and there is a high potential for connecting these areas through a wildlife corridor. Two patches between the HNP and NNP were found to be appropriate for the proposed corridor, one for leaf deer 165 km long and 2817 km^2, and one for takin 98 km long and 2403 km^2. The comparative altitudinal and horizontal coverage of the two species clearly indicated their habitat preference; takin showed higher altitudinal sub-alpine and alpine coverage and leaf deer a preference for temperate forested areas. Interestingly, while trying to identify corridors for both species, a broader connectivity coverage extending from alpine to temperate forested areas was found to be most suitable. This preliminary study has provided important insight into the significance of habitat connectivity between the protected areas and those lying outside them, and the prospects of developing wildlife corridors to support the idea of widening the extent of PAs by the three countries.

PRIORITY ACTIONS FOR REGIONAL BIODIVERSITY MANAGEMENT

Geo-spatial analyses of the type described here provide a valuable basis for putting areas or 'pockets' of unique flora and fauna outside PAs that are too small to be considered as regular protected areas into some form of protection arrangement, and for facilitating regional level efforts to maintain transborder vegetation contiguity, as well as for protecting landscape elements in the entire landscape. Strengthening the conservation of existing parks and other priority sites outside the PAs by maximising the synergies between biodiversity conservation and community development initiatives across the three countries will be a high priority in the landscape.

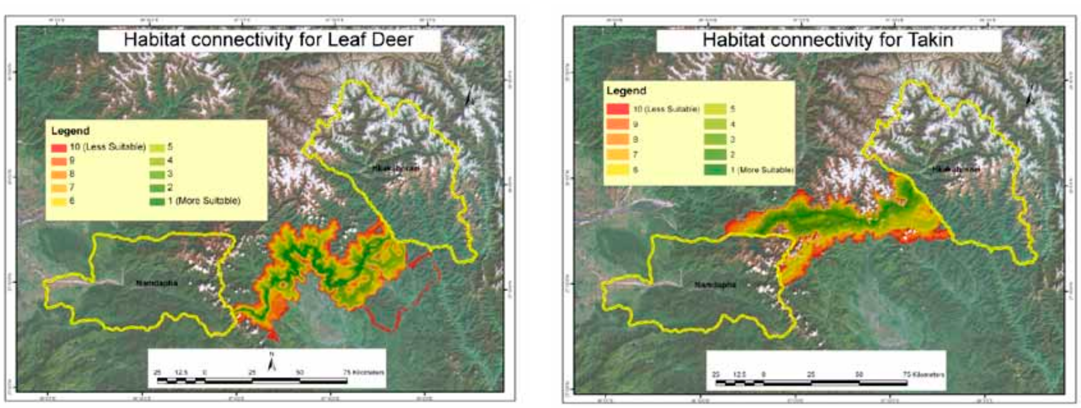

FIGURE 2. Suitable corridors between Namdapha National Park (NNP) and Hkakaborazi National Park (HNP) in the Brahmaputra-Salween Landscape, based on the habitat suitability model for leaf deer and takin.

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36. RAPID ASSESSMENT OF CIRCUM-ARCTIC ECOSYSTEM RESILIENCE (RACER): A FRAMEWORK AND TOOL TO GUIDE ECOSYSTEM RESTORATION MEASURES UNDER MAJOR CLIMATIC CHANGE

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Keywords: resilience, ecosystem restoration, ecosystem services, spatial planning, adaptation

INTRODUCTION

Over the last 50 years the Arctic has warmed at almost twice the rate of the global average. Arctic places and species are already affected by the change in climate which is quickly becoming the dominant threat to the viability of Arctic ecosystems.

The unprecedented rates of change forecast for the Arctic have led WWF to believe that ecosystem management and restoration approaches in the 21st century have to better incorporate change by targeting the resilience of the social-ecological system in question. This will require, among other measures, a detailed understanding of ecosystem structure and function as well as human adaptive capacity, and how they will likely respond to the direct and indirect impacts of climate change. To effectively manage, maintain and restore ecosystem functions and the services associated with them, ecosystem stewards – whether they are planners, managers, conservationists, industry or local people – need to know where to focus their efforts, both geographically and with regard to ecosystem functions.

THE RACER APPROACH AND METHOD

Given the significant biophysical data gaps for much of the Arctic and the challenges associated with projecting future conservation needs in the Arctic, the analyses required to carry out the above will demand some time and resources to complete comprehensively. As such, there is a clear need to provide interim products that identify where to concentrate efforts to strengthen or restore the viability of Arctic ecosystems, including the services they supply to people.WWF realizes the need to make progress fast and has carried out a Rapid Assessment of Circumpolar Ecosystem Resilience (RACER) to identify places conferring resilience of circum-Arctic marine and tundra ecosystems. The project analyses whether drivers underpinning system functioning –such as those supporting ecosystem processes, diversity, and ecosystem services– are resilient or vulnerable to the projected climate changes. Results point to places in the circumpolar Arctic where these drivers are likely to remain intact and thus have to be key targets for ecosystem management and restoration in an adaptation context. The project also provides a model structure for similar assessments at the regional or local scale.

FIRST RESULTS

WWF's team has designed and refined the method identifying places of future importance for ecosystem functioning and associated services with guidance from an international advisory group of Arctic conservation and climate experts representing both Indigenous and scientific knowledge. The model has been tested through assessments in two terrestrial and two marine eco-regions in the Russian and Canadian Arctic, where the results now inform and guide spatial planning and management efforts in those regions to incorporate the consequences of unprecedented rapid climatic change.

37. RESTORATION OF KOLE WETLAND ECOSYSTEM THROUGH PEOPLE'S PARTICIPATION

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Marancherry Kole wetlands consist of low lying tracts of wetlands about 0.5 to 1 meter below the mean sea level. Geographically it is positioned between 10^{0}20' and 10°44' N latitudes and 75°58' and between 76°11'E longitudes with an area of 18,632ha spread over Thrissur and Malappuram districts in Kerala state, India. This wetland comes under the Central Asian Indian flyway for continental migrants and is a part of the Ramsar sites in India. The "Kole" (a local parlance indicating bumper crop) wetland is a highly productive agro-ecosystem and also one of the most threatened ecosystems in Kerala.

The agrarian distresses due to several social and economical factors in Kerala obviously lead many farmers to abandon the paddy cultivation. Till the 80s, two distinct seasons of the paddy cultivation existed named season-wise as Mundakan (September-October to December-January) and *Punja* (February-May). The increase in the labour charge, unavailability of labours, increase in the coast of chemical fertilizers and insecticides, low profit out of the paddy cultivation and low price of the paddy cumulatively lead to the distress among the farmers. This has forced the farmers to convert of the paddy and kole wetlands for the cultivation of the profitable crops like the plantain, areca nut, coconut, rubber and tapioca. The state Government prevented the reclamation of the paddy land by the Paddy and Wetland act, 2010 which averted the reclamation of paddy land as well as turned away the use of paddy land for other purposes. Thus the paddy lands became fallow lands changing the entire ecological characteristics and invaded by species like *Colocassia Pistia*, *Eichornia* etc.

Much of this Kole wetlands are left unattended and the Kerala State Biodiversity Board took up a pilot study on conservation and enhancement of wetland biodiversity and livelihood improvement of the people in 500 acres of a Kole wetland. The project was implemented in a participatory manner involving Local Self Government Institutions, NGOs, Scientific institutions and Cultivator's societies. Discussions were held at Local Self Government level, along with representatives of Farmer Societies and State Agriculture and Fisheries Departments. The traditional method of fish and rice cultivation in the Kole Wetlands was revived and organic farming practices introduced.

The initial ecological assessments of the wetlands were made and the studies revealed that Marancherry Kole wetland ecosystem, exhibits higher levels of trophic status. Comparatively high nutrient levels, sufficient primary production, abundance and diversity of plankton and benthic organisms revealed that the ecosystem is quite productive. With respect to significant role of macrophyte vegetation as a habitat, shelter, food for a large number of fishes, and also their spawning ground, it is suggested that full potential of Marancherry kole wetland can be achieved by implementing proper wetland management methodology by adopting integrated farming techniques for a longer period. The relative growth of consumer organisms, including fish farming suggests this wetland to be a promising water body for the sustainable agriculture and fish production. The diversity of Birds, fishes, amphibians, copepod, Cladeocera, and plants were also estimated. The wetland is rich with benthic molluscs, arthropods and annelids.

The two year action oriented programme also revealed the enhancement of the wetland biodiversity of the area along with livelihood improvement. The data gathered during the study period confirm that the density of birds (water birds), molluscs (snails), fishes, aquatic arthropods (benthos and macro-invertebrates) have increased considerably. The survey among the farmers revealed that the shifting from the chemical farming to organic farming increased the density of many birds which were very according to their observation. The traditional fishery of this kole wetland has been sustained by the eels (*Anguilla bengalensis*, *A. bicolour*), carplets (*Amblypharyngodon melettinus*) small carps (*Barbodes subnasutus*, *Puntius dorsalis*, *P. filamentosus, P. mahecola*, *P. parrah* and cat fishes (*Mystus ocutatus*, *O. bimaculatus*, *Wallago attu* and *Heteropneustes fossilis*). As a part of the integrated farming, Indian Majtor Carps (IMC) like Catla (*Catla catla*) and Rohu (*Labeo rohita*) were stocked at the ratio of 1:2. Altogether 10,00,000 fingerlings were stocked during 2009. In 2010, 280 tonnes of fishes were harvested from the wetlands which worth Rs.1 crore.

The local farmers were also given training in organic farming practices and the rice and vegetable cultivation switched over to organic in the 500 acre area. Initially as expected, the productivity of rice was comparatively low under organic farming. However, this was compensated by the gains to the farmers through fish production. Also the organic rice fetched better price. By the third year, the productivity of the rice also increased. It is also assessed that the farmers could earn much through the the organic vegetable cultivation.

It may be worthwhile to mention that based on the positive results obtained during this pilot project, even the farmers who have abandoned agriculture in the adjoining Kole Wetlands have come forward and started agriculture through organic cultivation. An obvious change has been understood from the survey is that during 2007-08, 75.6% of the people were unaware of the organic farming. By 2010, 58% of the local population were shifted to the organic farming and were aware of the consequences of the chemical farming.

The major objective of livelihood improvement, along with conservation could be well demonstrated under this project. The most significant result of the programme was the restoration of biodiversity of this most critically endangered ecosystem through the organic farming. The experiment is also helped to mitigate the distress of the agrarian community in the area.

38. HEALTHY KIDS, HEALTHY FORESTS: RESTORING MAYANUT AGROECOSYSTEMS FOR A HEALTHY AND PROSPEROUS FUTURE FOR NEOTROPICAL COMMUNITIES

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Keywords: Brosimum alicastrum, Central America, child nutrition, non timber forest product, rural women, reforestation.

INTRODUCTION

Maya Nut (*Brosimum alicastrum*) is a nutritious, delicious, easy to harvest and process native rainforest tree food. It was a staple food for the ancient Maya and other Precolumbian cultures in Central America, South America, Mexico and likely Cuba, Jamaica, Trinidad and Tobago. Maya Nut is a canopy emergent and keystone species. Important as a food for many species of birds and mammals, including several threatened species e.g. scarlet macaw, yellow-naped parrot, spider, howler and night monkeys, bats, deer, wild pigs, tapir and others. Maya Nut is also an important source of nutrition for people. Maya Nut grows across a wide range of soil types and rainfall. As a result it can be found in most forest systems below elevations of 1200 m north of the Amazon. Because of its exceptional root system Maya Nut is also one of the most drought-resistant trees in Latin America, thriving in arid, degraded and marginal soils. Historically, thousands of villages have survived by eating Maya Nut when their crops failed due to drought, war or pests. With expected increases in the duration and severity of drought and the frequency and intensity of hurricanes associated with climate change, particularly in Central America and the Caribbean, it is likely that Maya Nut will again become an important source of food security for rural communities.

AIMS

The past century has seen the range of Maya Nut greatly reduced but within the past decade there has been a slow resurgence in interest in the cultivation, consumption and commercialization of the seed of this species. This has resulted in the species becoming important in reforestation initiatives, child nutrition and the development of sustainable women-dominated micro enterprises.

The aim of the Maya Nut Institute is to facilitate and promote the use of Maya Nut in reforestation programmes throughout its range so that the nutritional, economic, ecosystem service and biodiversity value of this species reaches its potential across the region. The Maya Nut Institute has contributed to the rescue of the lost indigenous knowledge about the species since 2001 and has developed a number of initiatives designed to increase the capacity of rural women to harvest, process and market Maya Nut, these include the 'Healthy Kids, Healthy Forests Maya Nut School Lunch' programme in El Salvador, Guatemala, Mexico, Haiti and Nicaragua and "Forest Friendly Ranching". The latter promoting the use of Maya Nut leaves as fodder for cattle in Guatemala, El Salvador, Peru and Haiti.

As well as representing an important species for reforestation Maya Nut also represents a strategically important species for the conservation of low to mid elevation forests in Mexico, Guatemala, El Salvador, Honduras and Nicaragua. This is because of the fact that Maya Nut is traditionally harvested, prepared, consumed and sold by women and children and so represents a unique opportunity to foster wealth creation and organisation by and for women. Within the context of conservation and environmental awareness in the developing world, these are two of the most high impact groups. They are also the least represented in the vast majority of development and conservation projects to date. Associating these elements to the conservation of forests and reforestation demonstrates tangible socioeconomic benefits to conservation at the community level.

In order to improve the scientific capacity to ensure the sustainable reforestation and harvesting of Maya Nut, the Natural History Museum in partnership with the Maya Nut Institute has developed a project funded by the Darwin Initiative (UK, DEFRA) 'Tools for the sustainable harvesting of Maya Nut'. This project aims to evaluate the genetic diversity of the species and its structure across Central America, to monitor the biodiversity associated with actively harvested Maya Nut forests and to develop storage protocols which will enable the long-term storage of viable seed. By working with the Maya Nut Institute and its network of producer communities the project also aims to connect the scientific knowledge generated with rural communities on the ground.

Knowledge of the species' genetic diversity is essential to underpin reforestation programmes. Genetically distinct populations may reflect specific 'adaptations' to drought tolerance, histories of domestication or correspond to variation in nutritional value. Knowing whether such genetic structure exists and on what geographical scale it is manifested is important when selecting seed for reforestation. This is because it will enable informed decisions to be made with respect to whether to source seed from a particular locality / trees, or not. For example, if there were little or no genetic structure then it would be possible to source seed indiscriminately from populations throughout the region.

Maya Nut seed is recalcitrant and remains viable (for germination) for less than a month after harvest. This complicates the use of the species in reforestation as seed must be sourced and planted quickly and seed for reforestation cannot be stored from one year to the next. Working with the Kew Millennium Seed Bank we will identify the preparation and storage conditions necessary to store viable seed for several years.


Erika Vohman

FIGURE 1. Capacity building in San Benito community, Guatemala. Women make up over 80% of those involved in the harvesting, processing and selling of Maya Nut.


Erika Vohman

FIGURE 2. Cattle being fed Maya Nut leaves in Yucatan, Mexico. Maya Nut leaves represent a very nutritious food for cattle, pigs, sheep, horses and mules and enables much higher stocking densities than would be possible with pasture.

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39. A BIRD, A FISH, A TURTLE: MANGROVE RESTORATION FOR ENDANGERED SPECIES AND HUMAN HAPPINESS

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Keywords: Mangroves, restoration, endangered species, ecosystem health, biophilia

INTRODUCTION

Mangrove losses world-wide are well-documented (Alongi 2002, Duke *et al.* 2007, Giri 2011). Reasons include conversion to aquaculture and farming, and tourism and navigation infrastructure. Several endangered vertebrate species use mangroves, particularly the iconic *Rhizophora,* for parts of their life history cycles. For them, removal of mangroves constitutes shrinkage of essential habitat and further contributes to their vulnerability. Three such species from Latin America and the Caribbean are considered here: the West Indian Whistling Duck, the Goliath Grouper and the Eastern Pacific Hawksbill Turtle. While individual mangrove species are tough and can survive stresses that kill ordinary plants, they are not infallible. Conservationists cannot keep up. The Mangrove Action Project (MAP), since 1992, has actively worked throughout the Tropics towards restoring degraded mangrove sites, principally abandoned aquaculture ponds, in collaboration with local communities. MAP favors using ecological principles to restore degraded sites, but is not averse to judicious planting of propagules as a community-fostering activity, or where there is no suitable seed source.

THE BIRD

The West Indian Whistling Duck (*Dendrocygna arborea*) is a mangrove denizen, emerging from its protective roost at dusk to feed. Once widespread throughout the Caribbean, it is now reduced to relict populations in a few islands, protected by its own society (www.whistlingduck.org) and the goodwill of a few concerned individuals. Habitat loss is cited as the prime threat to the duck's continued existence. In Puerto Rico alone, 70% of historically recorded areas of mangrove have disappeared, along with the Whistling Duck. Thanks to Mr. Willie Ebanks, there are more ducks on Grand Cayman than on the fourth largest island in the Caribbean (www.nationaltrust.org.ky). Restoration of natural vegetation along coastlines and inland swamps will provide roosting habitat for this charismatic creature listed on CITES Appendix II.

THE FISH

The Goliath Grouper (*Epinephelus itajara*) is one of the gentle giants of the Caribbean. Fished almost to the point of obliteration, its position on the US Endangered Species List is constantly challenged by recreational fishermen, as populations slowly recover. After being carried by tides from spawning aggregation sites on the reef, larval fish settle out into mangrove leaf litter and spend their 5-6 juvenile years in and around *Rhizophora* prop roots, feeding primarily on crabs and snappers. As adults, they move back out into deeper water where now their top predator role in controlling the invasive Lionfish (*Pterois volitans*) is being considered by the scientific community with hope and interest. Again, restoration of mangroves where they have been removed will contribute to the overall health of the coupled mangrove-seagrass-coral reef ecosystem.

THE TURTLE

The Eastern Pacific Hawksbill Turtle (*Eretmochelys imbricata*) is the only turtle that nests in mangroves; all other marine turtles nest in open sand beaches. Until recently supposedly extinct, populations have been identified in Baja California and along the mangrove coasts of El Salvador, Honduras and Nicaragua. Heroic efforts by the Iniciativa Carey del Pacifíco Oriental (ICAPO) are being made to recover populations from over-zealous egg harvesting and consumption. Education, egg purchasing and hatchery rearing are intensively pursued during the breeding season, and this is complemented by an initiative to promote ecological mangrove restoration in Central America. MAP and ICAPO are instrumental, in collaboration with EcoViva and the Salvadoran Asociación Mangle, in fomenting interest in the so-called "Corredor Mangle" to restore mangroves to the abandoned aquaculture ponds in the Gulf of Fonseca and the Bahia de Jiquilisco as part of the turtle rescue effort. Sea-level rise and the ever-present threat of mangrove destruction for tourism infrastructure make this an urgent imperative.

DISCUSSION

Conservation alone is insufficient to protect habitats for endangered species. The newly emergent field of restoration science is seen as a corollary to conservation in the absence of an ability to halt habitat destruction. People have lived simple, extractive lives in mangroves for millennia. It is only recently that mass-destruction of mangroves for non-basic needs has taken place, for example mass-chipping of mangroves to fuel the rayon industry in the Pacific. Most of the destruction of mangroves in the Caribbean and Latin America is simple conversion to more 'valuable' uses, such as shrimp aquaculture for export revenue, or luxury homes and resorts. It is largely non-consumptive, and imposed on local users who might hold usufruct in the form of a locally-managed commons of state-owned mangroves (Escobar, Stonich). Restoring the mangroves after the shrimp ponds have been abandoned due to disease or intensification-related poisoning, can act to restore the health and happiness of the local people and reconnect them with their former livelihoods (www.mangroveactionproject.org). Mangroves grow in places where hydrology and geomorphology favor them as a group of plants alone. They are the connectors between land and sea. People who live in mangrove areas know this, and value the livelihoods and spiritual enrichment that they obtain from this diverse biome, above any pecuniary remittance derived from conversion by insensitive outsiders. MAP has worked to restore mangroves in Thailand and Indonesia and helped to heal the violence attendant upon shrimp aquaculture. It looks forward to doing the same in the Gulf of Fonseca. In addition, biophiliac well-wishers for endangered species gain in the knowledge that something is being done to harmonize the discordance, other than helpless check-writing and hand-wringing. Although the former really helps!

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40. TOWARDS A LIVING JORDAN RIVER: A REGIONAL STRATEGY TO REHABILIATE THE LOWER JORDAN RIVER

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EcoPeace/ Friends of the Earth Middle East (FoEME) is a Jordanian, Palestinian, Israeli environmental peacemaking organization focused on the rehabilitation of the region's shared water resources. Having led efforts to date for the Lower Jordan River's rehabilitation, FoEME understands that a regional approach that brings all sides to act together is a pre-requisite for gaining the political support to return fresh water back to the River.

The Jordan River Rehabilitation Project's Environmental Flow Study (EFS) is part of a two-part study undertaken by FoEME to strengthen the knowledge base and enable political decision makers to act to rehabilitate the Lower Jordan River (LJR), an important wetlands area. The EFS answers the question – how much and what quality of water is required to rehabilitate the LJR? Complementing this study, FoEME undertook an analysis of the economic opportunities to save or produce fresh water resources from within the water economies of Israel, Jordan and Palestine which could potentially be returned to the Lower Jordan River.

The EFS was overseen by a Regional Advisory Committee involving governmental representatives from each of the riparian countries. The findings are alarming and require urgent concrete action from all parties in order to restore the River and preserve this important site of shared natural and cultural heritage.

This study exposed several significant and previously unpublished findings including:

- The LJR today is a highly degraded system due to severe flow reduction and water quality impacts.
- Over 98% of the historic flow of the LJR is diverted by Israel, Syria and Jordan for human use.
- The remaining flow consists primarily of sewage, fish pond waters, agricultural run-off, and saline water diverted into the LJR from salt springs around the Sea of Galilee.
- The river has lost over 50% of its biodiversity primarily due to a total loss of fast flow habitats and floods and the high salinity of the water.
- Long stretches of the LJR are expected to be completely dry unless urgent action is taken by the parties to return fresh water to the river.

The study concludes that the LJR requires 400 million cubic meters (mcm) annually, to be expanded to 600 mcm over time for the river to function as a healthy ecosystem. In addition, one minor flood event is required to take place annually, with the river's salinity level to be reduced to no more than 750 parts per million (ppm), meaning that primarily fresh water needs to be returned to the river with only the highest quality of effluents allowed up to 25% of the base flow. Implementation of this strategy would remove most of the disturbances, restore the river's structure and function, allow the natural riparian plant community to recover and restore stable communities of flora and fauna and achieve a fair to high ecosystem integrity and health. With the historic flow of the river averaging 1.3 billion cubic meters the conclusion of this study recommends that less then a third of the historic flow be returned.

Furthermore, as the complementary economic analysis of policy opportunities to return fresh water resources to the LJR shows, a broad range of policy options exist to reduce water demand or augment supply in Israel, Jordan and Palestine. The economic analysis identifies the water-saving potential of several such policies and measures the estimated costs of each, ranking these policies in terms of cost effectiveness. Of the options examined in this study, nearly 517 million cubic meters (mcm) of water per year were was identified as being available for conservation in

Israel, 288 mcm in Jordan and 92 mcm in Palestine, at less than the marginal cost of water. In all, nearly a billion cubic meters of water can be saved in the region—part of which, from Israel and Jordan, can be utilized to meet the rehabilitation goal for the Lower Jordan River and to restore Palestinian water rights.

FoEME RECCOMMENDS:

Ecological Rehabilitation:

- Remove contaminants from the Jordan River and supply water back to the River in sufficient quality and quantity.
- As treatment solutions are found to halt the release of sewage into the Lower Jordan River, governments must commit to return fresh water to the River.
- Based on scientific studies conducted by FoEME, we recommend that the three governments should adopt a regional rehabilitation goal to **return 400-600 million cubic meters** of high quality water back to the Lower Jordan River each year.
- Rehabilitation can be accomplished through water conservation and increased efficiencies. In a recent review of the Jordanian, Israeli and Palestinian water economies, **FoEME identified over a billion cubic meters of water that could be saved/produced by implementing identified conservation strategies. Water saved can be used in part to rehabilitate the Lower Jordan River and restore Palestinian water rights.** 90% of the identified water savings were found to be less expensive than the marginal cost of water.

Shared Benefits:

- Palestine, Jordan and Israel can share in the benefits of a rehabilitated Lower Jordan River by establishing cross border tourism routes and transboundary peace parks such as the proposed Jordan River Peace Park at Naharayim/ Bakoura and the proposed transboundary Baptism Site.

Regional Master Plan Development:

- Launch and implement a comprehensive master planning programme to rehabilitate the Lower Jordan River and its tributaries.
- Master plan should determine coordinated regional flow regimes, set water quality standards, identify solutions to treat all pollution sources, launch restoration and preservation programs, establish ecological corridors, and identify opportunities to expand ecotourism infrastructures in the Jordan Valley including the preparation of regional heritage routes.
- Preparation of a master plan has political support in Israel and Palestine.
- The Israeli government has launched a process to prepare a master plan for the Israeli section of the Lower Jordan River.

Regional Management Mechanism:

- Establish a Jordan River Basin Commission to manage the River while instituting mechanisms to mitigate conflicts and strengthen the integrated water resource management of the Lower Jordan River.

41. COMMUNITY-BASED HABITAT RESTORATION: RESTORING CALIFORNIA'S NATURAL HERITAGE ONE VOLUNTEER AT A TIME

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INTRODUCTION

Community-based habitat restoration is an important tool in recovering the natural heritage of California. Through sound ecological restoration and quality environmental education, community-based restoration is using proven methods to improve California's natural and human communities.

Community-based habitat restoration is completed throughout California by citizens passionate about the areas in which they live. Community-based restoration can take many forms and works within many habitats but there are main goals that resonate with all effective community-based restoration programs:

1. Natural and cultural histories are valued.
2. Projects are scientifically sound.
3. Their work is shared with the community.

Trying to reach these goals is a challenging endeavor and never easy. How do community-based restoration programs maintain their effectiveness with limited staff and funding resources? Where can community-based restoration programs find new information to make efficient use of their volunteers' time and energy while providing the best in training and volunteer education? Where can program coordinators find information specific to their habitats in a place as unique and varied as California? How can interested volunteers find a place to work?

THE NEED

There is a strong need for non-profit organizations and government agencies leading CBR programs to collectively address these questions and more. While individual programs may enjoy success within their own communities, the field of community-based restoration is growing and would benefit tremendously from the formation of a "community of practice." A community of practice would provide a way for practitioners to share tips and best practices, ask questions of their colleagues, and provide support for each other (Wenger et al. 2000). In particular, there is a strong need for:

1. A source for standardized training for new staff and volunteers in leading community-based restoration projects.
2. A clearinghouse of information including relevant updated ecological restoration and environmental education information (especially research articles), relevant funding sources, news items, resource directory and catalog of products and techniques.
3. A social network by which groups can share their successes and challenges while teaching and learning from each other.

DISCOVERING THE NEED: A BACKGROUND

The California Coastal Commission instituted the Community-Based Restoration and Education Program (CBREP) at the Upper Newport Bay in 2002. Based on the experience learned from guiding this effort, the Commission published *Digging In: A Guide to Community-Based Habitat Restoration* in 2008. The guide explains the basic steps of information gathering, site selection, project implementation, monitoring, maintenance, and working with volunteers. It includes tips on battling non-natives, as well as propagating and installing native plants (Finstad et al. 2008).

Digging In was immediately popular among non-profit groups, government agencies, teachers, and individual volunteers. A common theme and underestimated value of these workshops was the opportunity for participants to network amongst themselves. Many of the programs represented at the workshops were occurring independently within miles of each other. The need to fill the gaps in knowledge and communication between groups became self-evident.

MEETING THE NEED

CBREP has the following goals to meet the needs of community-based restoration practitioners:

- Provide resources necessary to promote and encourage community-based restoration as a tool for habitat recovery.
- Engage and empower communities to restore and protect native biological diversity throughout California
- Grow a community-based restoration network targeting professionals (government agency and non-profit), volunteers, and educators.

CBREP will reach these goals using the following tools:

- Monthly trainings, including indoor lectures and discussions as well as field work components
- Advanced workshops to address more in depth the component parts and issues that define community-based restoration
- Custom on-site trainings and workshops (by request)
- Clearinghouse website with resource directory, program highlights, archived research papers, news items and catalog of products and techniques
- Social media (such as www.facebook.com/cbrep) for use in maintaining dynamic relationships with practitioners.

More program information is available at www.coastal.ca.gov/publiced/UNBweb/cbrep.html.

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KEYWORD INDEX

AUTHOR INDEX